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FIFTY-SIXTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

TWENTY-FIRST ANNUAL REPORT OF THE MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION.

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State Board of Agriculture, 1909.

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Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1910
Massachusetts Horticultural,	WILFRID WHEELER of Concord,	1912
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1912
Middlesex North,	GEO. W. TRULL of Tewksbury,	1911
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1911
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Oxford,	WALTER A. LOVETT of Oxford,	1910
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Spencer (Far's and Mech's Assoc'n),	W. J. HEFFERNAN of Spencer,	1910
Union (Agr'l and Hort'l),	GEORGE O. MILLARD of Blandford,	1910
Weymouth (Agr'l and Ind'l),	THERON L. TIRRELL of South Weymouth,	1912
Worcester,	B. W. POTTER of Worcester,	1911
Worcester East,	GEO. F. MORSE of South Lancaster,	1912
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Worcester South,	C. D. RICHARDSON of West Brookfield,	1910
Worcester County West,	JOHN L. SMITH of Barre,	1911

THE FIFTY-SIXTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

In submitting my report for the year 1908 I find much that is of interest to the farmers of Massachusetts, in both the practical phases of the work of the Board and in the history of agricultural development and legislation during the year. The year has been one of marked progress in development and legislation for the benefit of the farmers. The milk question was discussed at length before the Legislature, with enthusiasm and interest in many cases rather than with temperance and restraint, and legislation finally secured which should be thoroughly tried out before other changes are asked for. The office of State Ornithologist was established, and this work put upon a safe footing. Liberal appropriations were granted to the Board, and to the other agencies for agricultural improvement which are dependent, in whole or in part, upon assistance from the Commonwealth. The long-sought greenhouses were secured for the Massachusetts Agricultural College and that institution generally fared very well at the hands of the General Court. All that was asked for was not secured, nor can we expect that such will be the case; but in all lines there was a marked disposition to recognize the needs of the farming class to a greater extent than heretofore. It is not well to be satisfied with anything less than the very best in the way of legislation and work for agricul-

ture; but, on the other hand, the spirit that holds that because the best was not secured that which was granted is of no avail, and that criticises and complains, holding that all is lost because all was not gained, is not the spirit which will bring the greatest results in the future. The kicker is a necessary element of all progress, — the crank, the man with one idea, is the man who starts things moving; but the perpetual kicker soon wears out his welcome in the halls of legislation, and fails to secure that which he seeks because he seeks not wisely.

On the side of farming from the farm standpoint, the production of crops and the making of a living from the farm, the season has been only an average one for our farmers. The most marked feature of the year has been the prolonged drought, which, commencing early in the summer, has continued almost without interruption up to the present time. The precipitation for the year has been far below the normal, and, though what little rain there was came at times that made it the most effective, so far as keeping farm crops growing was concerned, streams, wells and springs failed in many sections and remain dry at present. This causes much inconvenience to farmers, especially in dairy sections, but fortunately the damage has not been as great as it might have been.

Crops have been fairly good in most lines of farming, but prices have, perhaps owing to the prevailing industrial depression or to other causes beyond our power of discernment, been rather lower than for the past two years. This, taken with the not better than average crops and the high prices of all that the farmer buys, have tended to keep down profits.

It is seldom that a corn crop has been secured of greater value to the farmers of Massachusetts, both for grain and stover. The hot, dry weather of midsummer, which checked the development of many other farm crops, was just what was needed for the development of the corn crop; and the continuance of these conditions at time of harvest led to the quick curing of the stover, producing a bright, clean stover of extra feeding value. The crop of ears was unusually good, and where the crop was grown for ensilage it was put into the silo in the very best and most valuable condition. The hay crop was only a fair one, a good first crop, in most sections,

being followed by a very light second crop, which reduced the total production for the year to a very material extent.

Dairy products brought the same prices as the previous year, and with slight reductions in the price of grain it would seem that profits should have been greater than for some years past, though this was counteracted in a measure by failing pastures, caused by drought, and the increased necessity of feeding grain at the barn. As last year, I would urge that the price of milk is not yet on the level that it should be to enable the producers to secure a fair return for their investment and labor, and that everything should be done to make such an advance a certainty in the near future. The standard set by the demands of the market and the controlling departments of the Commonwealth is a high one, and it must be maintained, so far as the purity and cleanliness of the product are concerned. If it is to be maintained, however, the public must be educated to appreciate the food value of milk and the cost of production of a first-class article, so that they will be willing to pay for the same; and the contractors must be made, by public opinion, to feel that they have a duty to the producers as well as to the consumers. Strict sanitary regulations are a necessity, from both the business and the health standpoint; but where they entail an additional expense, that expense must not be placed upon the producer, as his margin of profit is already so small as to be in danger of becoming nonexistent.

Butter has generally brought good prices, and the dairy business, as our fathers knew it, — the production of butter and the breeding of dairy stock, — must have been profitable to those who have pursued it with intelligence and foresight. The demand which exists for good dairy cows makes their breeding a fine source of income to the farmer who is so situated that he finds that line of work congenial and practicable.

The season was only a fair one for our horticulturists. The apple crop was better than was expected early in the year, and prices have been high; but the fruit was rather small and prematurely ripened, so that its keeping qualities were impaired. Well-cared-for orchards, however, were ex-

tremely profitable. Peaches were a fair crop in some sections and brought good prices. Pears were an average crop, contrary to early indications. Plums were a light crop in almost all sections. Grapes were a very heavy crop, and secured without damage from frost. Cranberries were a very light crop, owing to drought, frost and insect damage, but have brought very high prices.

Our horticulturists are urged to be on their guard against the San José scale, now distributed in almost all sections, and sure to be the destruction of an orchard where it is not detected in its early stages. Another menace to the business of orcharding, and one for which the State is directly responsible, is that from the wild deer, so common in many fruit-growing sections. They do no damage to full-grown trees, but in many sections it is impossible to set out young fruit trees, except in immediate proximity to the farm buildings, with any expectation that they will not be browsed off and killed by the deer. Our present orchards will not live forever, and must be replaced; but in many sections this will be impossible, unless these animals are driven away or destroyed. So many reports of such damage have come to the Board that it seems as if those interested in fruit growing should unite to secure legislation looking to an abatement of this nuisance.

Market gardeners were much less successful than usual during the year. They generally secured fairly good crops, heavy manuring and constant cultivation making up very largely for the deficiency in the rainfall; but the prices secured were never up to what might reasonably be expected. This is attributed, by those best informed, to the effects of the industrial depression, consumers apparently retrenching by curtailing their consumption of the more expensive table delicacies, thus producing an oversupply and consequent lower prices. The same situation must have prevailed to a large extent in relation to the production of small fruits and berries, but it did not come so immediately to our notice.

Onions were a good crop, especially in the Connecticut valley, and generally brought very good prices. Tobacco was a good crop, but suffered severely from hail and wind damage

in some sections. Prices are generally reported very good where the crop was secured undamaged.

Poultry products brought good prices throughout the year, and with the somewhat reduced prices of grain the profits of the business must have been fully up to any year. Intelligent care for the farm flock would do much to increase the profits on many a farm. There are many instances where a hundred hens pay the entire grocery bill for the year for the family, and that without especial care. Not being a cash crop, the egg returns are not valued at their true worth on many farms.

There are two points I wish to urge upon the farmers of Massachusetts as worthy of their careful attention. First, it is my firm conviction that a great deal more attention should be paid to the corn crop than has been the case in recent years. Our farmers have fallen too much into the habit of purchasing all the grains that they feed, and have neglected this crop, with the result that when the price of grains leaped up a few years ago, the margins of profit were wiped out for many feeders. In Indian corn we have a crop which can be produced with a fair degree of certainty in New England, and which is valuable for feeding all kinds of farm stock. While its value for milk production is less than that of many other more concentrated feeds, it can be used to good advantage for the main bulk of the grain ration, being supplemented by boughten grains. The stover forms an excellent roughage for the feeding of most kinds of farm stock, and gives an additional value to the crop as a whole. Care in the selection of seed, planting only those varieties which have been proved to be adapted to the climate, and breeding for increased product and earlier ripening, will do much to improve the total yield. Some of the heaviest crops of early dent corn ever produced have been grown in New England; and if our farmers will give this crop the careful attention which they do many others of less importance, they will soon have little reason to care whether the prices of grain increase or decrease in the general market.

Second, the apple crop should receive careful attention. New England fruit does not to-day rank well enough, when compared with that from the west, so that first-class prices

can be secured for home-grown fruit. This is all wrong. With the market at our doors, it is the fault of the producer that our native fruit does not command the highest price of any fruit put upon the market. More care should be given to the production of the apple crop, cultivation of orchards should be the rule rather than the exception, and better methods of grading and packing should be adopted. Thus and only thus can New England fruit take the position that it should occupy, — at the head instead of the foot of the market. Our farmers have a gold mine at their hands, if they will but develop it. A ten-acre orchard on any New England farm, intelligently and carefully cultivated and cared for for ten years, with the fruit handled according to the most advanced methods, will prove the most profitable branch of farming.

Milk Legislation.

There were many bills looking to the betterment of the milk producer introduced at the last session of the Legislature. Most of these bills were aimed at the milk standard, and sought to do away with it, or correct its inequalities; but there were others which sought to regulate the conditions of transportation and production. Of all these bills, those which sought to do away with the milk standard altogether were urged with the greatest earnestness and had the widest support from the milk producers. There was never a chance that such legislation would be enacted, nor, in my judgment, is it likely that there will be a chance of its success in the near future. Whatever may be the merits of the contention, we must remember that the Legislature as a whole represents the consuming elements of the public; and the consumers have not been brought to believe that some standard is not necessary for their protection, nor are they likely to reach that point for some time to come. As, if the consumer will not consume there is no use for the producer to produce, we must regard the ideas and prejudices of the consumers to a certain extent; and, while we can always try to show that they are unfounded, and so lead them to modify or give them up, we cannot, as good business men, say that we will not

regard them or cater to them at all. The final outcome of all the agitation was the enactment of a law making the milk standard 12.15 per cent total solids, of which 3.35 per cent shall be fat, throughout the year, instead of the dual standard that has prevailed for so long. This is a compromise measure, not pleasing in every respect to any of the parties interested; but it is definite legislation, and so worthy of a fair trial by the farmers and the consumers, before its amendment can be properly asked for by either party. I would therefore recommend that this Board oppose any legislation at the coming session of the Legislature looking to a change in the milk standard law. Give the law a fair trial before asking for its repeal or amendment. The provision which I urged at the last session, for the sale of milk under a guarantee of total solids and fat content, did not meet with sufficient favor to become a part of the law. I still believe that it is the only fair solution of the problem, and would do much towards doing away with the present difficulties in the milk business. Nevertheless, I should not consider it wise to urge it upon the Legislature at this session, and merely record my belief in the plan, with the hope that it may become a part of the law at some later and more fitting time.

There was also legislation in amendment of the existing law in relation to the marking of vessels containing milk with the name of the party selling the same, and in relation to the proper marking of heated milk. Both these enactments were steps for the improvement of conditions in the milk business, and worthy of commendation by the producers.

The enforcement of the law so far as the Dairy Bureau of this Board is concerned, during the past year, has been along conservative lines. Prosecutions for the violation of the milk standard law, where such violations are unintentional and without fraud on the consumer, are unwise. It is better to warn the producer, and give him a chance to bring his milk up to the standard, before prosecuting. The object of the law is the protection of the consumer, and this is better secured by the leading of the producer to bring his products up to the mark set by law, without prosecution, than by immediately haling him into court to answer for a technical vio-

lation of which he was very likely entirely ignorant. The latter course savors too much of persecution to be one which this Board can commend.

There is one suggestion which I have to offer, which I hope will result in legislation at this session. At present, when a contagious disease is reported on the farm of a milk producer his milk is shut off from the market, and he is obliged to lose it entirely. It would be much better if the State would pay for the milk in all such cases. Such a course would do away with any disposition on the part of the producer to conceal the true condition of affairs, and would therefore lead to the better protection of the consuming public. I would recommend that the Board authorize its secretary to prepare such a bill and present the same to the General Court, and instruct him to urge its passage to the best of his ability.

Changes in the Board.

The Board lost during the year one of its most valued members by the decease in March of Hon. William H. Spooner, delegate from the Massachusetts Horticultural Society. Mr. Wilfrid Wheeler of Concord was chosen to fill the vacancy.

Mr. Noah Sagendorph of the Spencer Farmers' and Mechanics' Association has resigned, after two years of service. Governor Curtis Guild, Jr., retires after six years of service. Mr. Wm. N. Howard of the Bristol County Fair, Inc., retires after one year of service, because of the failure of said society to hold a fair in 1908 and so become eligible to State bounty and a delegate on this Board.

Changes in membership resulting from elections by the several societies will be given in the report of the committee on credentials in the proceedings of the annual meeting. Members retiring because of expiration of term of service are: Samuel B. Taft of the Blackstone Valley Agricultural Society, after eleven years of service; Edmund Hersey of the Hingham Agricultural and Horticultural Society, after thirty-two years of service; William A. Bailey of the Hampshire, Franklin and Hampden Agricultural Society, A. M.

Stevens of the Hoosac Valley Agricultural Society, Edwin L. Boardman of the Housatonic Agricultural Society, Col. H. A. Oakman of the Marshfield Agricultural and Horticultural Society, each after three years of service; H. G. Worth of the Nantucket Agricultural Society, after six years of service; and William A. Kilbourn of the Worcester East Agricultural Society, after eighteen years of service.

Meetings of the Board.

On June 5, 1908, the Board held a summer field meeting on the grounds of Mr. C. A. Bronson, at Ashfield, with the usual demonstrations, as the principal feature of the meeting. This meeting was held at this place so that the farmers of a large and thriving agricultural section, but one which is not easy to get to or from for a single day's trip, could have the benefits of this class of work, which they had not previously enjoyed. In other words, as there were but few of them who could come to these meetings, the meeting was taken to them. The attendance was purely local, and was very satisfactory. Proper methods of grading and packing fruit, the points of the dairy cow, the soundness of the horse, and proper methods of budding, grafting and pruning fruit trees, were the subjects demonstrated.

A second meeting was held on Barre Common, at Barre, on Aug. 21, 1908. This meeting was well advertised and well attended, both by local people and those from a distance. The points of the dairy cow, the soundness of the horse, and the proper methods of budding, grafting and pruning fruit trees, were again demonstrated. A new subject at this meeting was the demonstration of the proper methods of handling and hiving bees, with an observation hive, and instructions as to best methods of keeping them, by Dr. James B. Paige, professor of veterinary science at the Massachusetts Agricultural College.

The public winter meeting of the Board was held at Greenfield, on the invitation of the Franklin County Agricultural Society. The programme was a varied one and the meeting of great interest, but the attendance was a disappointment. Greenfield does not seem to be a good place to secure an

audience for agricultural lectures and discussions, but, as the lectures will appear in the annual report of the Board, the local people were the only ones to lose by the nonattendance. The Greenfield Board of Trade tendered an excellent banquet to the Board of Agriculture and others attending the meeting, on Wednesday evening. Prof. Rufus W. Stimson, director of Smith's Agricultural School at Northampton, was the principal speaker. Other speakers of the evening were Lieutenant-Governor-Elect Frothingham and Representative Walker of Brookline.

The annual business meeting of the Board was held at Boston, on Jan. 12 and 13, 1909, and special business meetings were held at the Barre summer meeting and at the winter meeting. The minutes of these meetings, with reports of committees, will be included in this volume.

Agricultural Societies.

The dry weather of the year, while detrimental to most agricultural interests, seems to have been favorable to the fairs of the agricultural societies. There has never been a year when there were so few fairs suffering from unfavorable weather, the only drawback to the enjoyment of most of them being the clouds of dust that were created by the trampling of men and animals on the dry and sun-baked grounds. The industrial depression does not seem to have affected their receipts materially, probably because people are much more willing to curtail on necessities than on pleasures; and the balance should be on the right side for almost all of the societies of the State.

The matter of the revision of the premium lists of the societies was referred to a committee at the last annual meeting of the Board. That committee met and gave the matter careful consideration. It will render its report through its chairman, and I will not anticipate it at this time. I will merely say that I consider its suggestions to be excellent ones, fully in line with those which I have made in the past, though worked out to better advantage, and would urge that the Board adopt them and make them a part of its rules for the government of the agricultural societies.

Last year we offered to furnish demonstrations to such societies as might ask for them. There was but one application, and that was not filled, owing to the impossibility of securing a man at that time capable of conducting it. We will hold the offer open for another year, and if any society cares to avail itself of the offer, they may find its terms by reference to my report for 1907, under the heading "Agricultural Societies." It would seem that this was an opportunity which ought not to be neglected by the societies of the State.

Farmers' Institutes.

Considerably more institute work was done during the year than in previous years, with very satisfactory results. This was because of the increased appropriation for the "dissemination of useful information in agriculture," of from \$3,000 to \$4,000, which first became available for the entire institute season during 1908. We were able to furnish more speakers for the agricultural societies, to grant institutes in territory not covered by the societies and for various State organizations, to a greater degree than ever before, and in addition were able to pay extra compensation to speakers who delivered lectures at two successive sessions. This led to the holding of more two-session meetings, with dinner and social hour between, — a very satisfactory and successful form of institute.

We had but three circuits of institutes during the year, Dr. Geo. M. Twitchell of Maine, Dr. J. L. Hills of Vermont and Prof. Alfred G. Gulley of Connecticut being the speakers. The first two gentlemen had full circuits, but there seemed very little interest in the subject of fruit growing at the time that Professor Gulley was secured, so but two institutes were arranged for. This seems the more regrettable as Professor Gulley is a speaker of the first class, and the subject one of the most important to Massachusetts farmers. However, Professor Gulley is located at Storrs, Conn., and is easily available at most times for institute work, so that any society failing to engage him last winter can easily do so for this year.

There does not seem to be as much interest taken in these

circuits as was formerly the case, possibly because our regular list of speakers has been materially strengthened in the last few years, and I have therefore decided to hold only one such during the present winter. Dr. Twitchell will be here the first week in February, as your officers and institute managers were advised by our circular letter of Dec. 31, 1908, and will be available at that time. Suggestions as to how this circuit work may be popularized and strengthened will be welcomed by your secretary.

One hundred and thirty-six meetings were held during the year, with 187 sessions. All the societies on the Board held 3 or more meetings, with the exception of the Middlesex South and Spencer agricultural societies, which held but 2 each, the arrangements for the third meeting having unexpectedly failed in each case; and the Massachusetts Society for Promoting Agriculture, which is represented on the Board by special enactment and is not required to hold institutes. Ten societies held 4 or more meetings, while 20 meetings were held in sections not covered by societies represented on the Board, or by organizations devoted to special interests in agriculture and with membership covering the State or sections of the State much greater than the limits of the agricultural societies situated therein.

The average attendance for the year shows a falling off, due to a variety of causes, chief among which has been the effort to strengthen the work and awake an interest in sections that have previously been apathetic, by holding more than the usual number of sessions. The attendance is computed on the basis established by the National Association of Farmers' Institute Workers, by the session, the attendance at each session being added together to obtain the grand total, and the average being obtained by dividing that by the number of sessions. The average attendance per session was 111, as against 118 in 1907, 127 in 1906 and 125 in 1905. The highest average attendance before 1905 was 109 for 1904, the figures ranging down from that point to 94 in 1899, when the record of attendance was first kept. The past two years show a decided check in the up-swing, and yet we are convinced that there has been more and more

interest in this work each year. With favorable conditions there will doubtless be a new increase in average attendance.

On Nov. 16 and 17, 1908, your secretary attended the annual meeting of the National Association of Farmers' Institute Workers, at Washington, D. C. The meeting was as interesting as usual, and your secretary there had an opportunity to meet with the workers from all over the United States and from several of the Canadian provinces, and it is to be hoped that he benefited from the exchange of ideas to some degree, so that the work in Massachusetts may have the advantage of suggestions derived from outside sources. He was honored by election as president of the association for the coming year, showing that the work in Massachusetts is recognized as worthy of commendation, which deduction is borne out by any analysis of the figures of attendance and expenditure, as shown by the reports of the officers in charge of the work in the various States and provinces.

Conference of New England Governors.

On Nov. 23 and 24, 1908, a conference of the Governors of the New England States was held at Boston, with essays by experts and discussion and speeches by delegates. The official delegates consisted of the Lieutenants-Governor, the Attorneys-General, Presidents of the State Senates and Speakers of the State Houses of Representatives, the members of Congress and United States Senators from the New England States, with prominent citizens named by the Governor of each State, the allotment for each State being two for each United States Senator and Representative. The object of the conference was to discuss and devise ways for the conservation and improvement of our natural resources, by the enactment of uniform legislation or otherwise. The subjects discussed were forestry, orcharding, shellfisheries and highways; and among the speakers were Hon. Gifford Pinchot, Prof. John Craig of Cornell University, Dr. George W. Field of the Massachusetts Fish and Game Commission, Harold Parker, chairman Massachusetts Highway Commission, James H. Macdonald, State Highway Commissioner

of Connecticut, and Hon. N. J. Bachelder of New Hampshire. The addresses were exceedingly interesting and valuable, the discussions pertinent and illuminating, and many valuable suggestions were advanced for the improvement of these resources in New England. Your secretary was present at all sessions, and was much interested in the deliberations of the conference. One direct result was the appointment of committees, consisting of the proper officers of the various States, to consider the question of uniform legislation throughout New England on the important subjects of forestry and forest fire regulation, grading and packing of fruit, nursery inspection, shellfisheries, highways, etc. Some of these subcommittees have already met and drafted proposed laws, which will be submitted to the various State Legislatures at the sessions now in progress. That in which we are most interested is the bill for uniform laws in relation to nursery inspection, which will be referred to again under that head. The subcommittee having this matter in charge met at this office and considered the question carefully, also that of uniform grading and packing of apples. The committee did not find it feasible to suggest any legislation on this latter point at this time. They did, however, recommend that a New England apple show be held at Boston in October of 1909, and appointed a committee to advance the matter, local arrangements being left to this Board and the Massachusetts Horticultural Society.

More important, in the judgment of your secretary, than any direct result attained by the conference, was the spirit of unity and community of interest among the New England States which it fostered, and its tendency to break down the artificial barrier of State lines, and to bring to the community a sense of the fact that New England is really a unit in all save the artificial political divisions, — one in interest, in resources and in policy, if we are wise, — and that what is good for one State is good for all. It is expected that this conference will become an annual feature, and it is certainly desirable that it should.

Bee Keeping in Massachusetts.

Few people appreciate the importance of the bee industry in Massachusetts, or the number of those interested in it. There are no figures available later than those for 1899, from the United States census, the State census not having been worked out in detail as to agricultural products; and the increase during the nine years since the figures for the United States census were taken has been very marked. This Board has endeavored to increase the interest in this line of work, and to assist the bee keepers of the State in every way possible, — by bulletins, lectures and demonstrations. During the past year three institute lectures have been delivered before societies of bee keepers, under the auspices of this Board; and at our public winter meeting at Greenfield a lecture was delivered by Mr. Charles Stewart, Bee Inspector of New York, dealing with the whole subject of bees and honey production. This industry is menaced by the appearance in many sections of the disease known as "foul brood," and if it is not checked it will eventually spread over the State and practically wipe out this promising industry. Last summer this Board gave a demonstration, at the apiary of Mr. E. N. Fisher of Ludlow, of the method of combating this disease, with Mr. Charles Stewart as demonstrator. This demonstration will be repeated in other sections where the bee keepers request it. There is agitation among the bee keepers for an inspection law similar to that in New York, where the inspectors have authority to compel bee keepers to abate the nuisance caused by the presence of foul brood in their apiaries. This system of inspection has saved the industry in New York, and, though that State has a great deal more capital invested in the business than Massachusetts, it still seems as though something should be done for the protection of the industry in this State. Just what should be done is a matter for future determination; but I would recommend that the Board direct its secretary to look into the matter, and to favor any legislation which, in his judgment, shall seem reasonable and likely to be of assistance to the bee keepers of Massachusetts.

Nursery Inspection.

The work of the Nursery Inspector has proceeded during the year with the usual inspections of nursery stock and about the usual results. This work is becoming increasingly difficult, through the lack of uniformity in the laws of the various States, the lax inspection in some States, and the practice of nurserymen to purchase their stock to fill orders from others, either within or without the State. It is complicated also by the increased spread of the gypsy moth and the San José scale, — the two most dreaded insect pests, from the standpoint of the orchardist. We are informed that efforts are making for uniform legislation throughout the country, which will do away with much of this difficulty, and it is our hope that it will be secured, though we anticipate considerable difficulty.

The law allowing the Nursery Inspector to declare trees and plants infested by insect pests a nuisance, upon complaint of the party endangered by them, has not been availed of by the owners of property in the State. There seems to be a considerable degree of ignorance in regard to the provisions of the law, and a certain degree of hesitancy about making complaint against neighbors, even in the face of certain danger. It would seem that the Board might well, through the Nursery Inspector, take some means to disseminate a knowledge of the law among the people. I would recommend that the committee on gypsy moth, insects and birds be instructed to consider this matter, and take such steps as may seem best in the premises.

The conference of Governors, previously mentioned, referred the question of uniform laws against insect pests to a committee consisting of the State Boards and commissioners of agriculture and the official entomologists of the New England States. That committee met at this office and appointed a subcommittee, which drafted a law to be presented to the Legislatures of the New England States, with whatever local modifications might be necessary by the particular circumstances as to officers and control of the work. This matter is under the charge of the State Nursery Inspector, and a bill will be presented to the Legislature, in-

cluding these changes. I would recommend that the Board instruct its secretary to appear in favor of this bill, and do all that he can to secure its passage.

Dairy Bureau.

The details of the work of this Bureau appear in the report of its general agent, which is printed elsewhere in this volume. We therefore need not go into detail here, but I would simply say that the work has been carried on efficiently and honestly during the year. I wish in particular to compliment the Bureau on the sound judgment shown in its prosecutions under the milk standard law, prosecutions being begun only where the milk contained added water. In all cases where the trouble was a failure to reach the standard, with pure, wholesome milk, the owner has been warned, and suggestions have been offered as to the best method in which he could bring his milk up to the legal standard. Owners have proved that this course was the proper one by taking the necessary steps and improving the quality of the milk produced by them, except where they felt that their purposes could be better served by withdrawing the milk from sale as whole milk. In either case the entire purpose of the law was served, and the producers were not subjected to costly and useless prosecution and notoriety. The violations of the oleomargarine and renovated butter laws decreased during the year, owing to the excellent work of the Bureau and its agents. Every year it becomes more difficult to detect violators of the law, and the Legislature of 1908 recognized the value of the work and the added expense involved by increasing the appropriation from $7,000 to $8,000. More inspections have been made than ever before, and more careful detective work carried on.

Cattle Bureau.

The report of the Chief of the Cattle Bureau will be found printed elsewhere. It is made to this Board, in accordance with the law, that being the only connection between the two bodies, and under these circumstances any comment upon the Bureau or its work would appear to be superfluous.

State Forester.

The work of the State Forester is independent of the Board, his only connection being that of an ex-officio member; but he is required to report to the Board, and that report will be found printed in this volume. The work has gone on during the year in a satisfactory manner, the Legislature being very liberal in the matter of legislation. A start has been made on the planting of forest tracts by the State, as so often recommended by this Board and its officers and members. Not much can be done with the means afforded at present, but it is still a beginning, and we look to see a steady increase of this work.

State Ornithologist.

The Legislature of 1908, acting on the request of this Board, passed a law establishing the office of State Ornithologist, to be filled by election by this Board. The duties in general of the office are to investigate the distribution and food habits of birds, to determine the relations of birds to the outbreaks of insects and other animals, to experiment with a view to discovering the best methods of protecting fruits and crops against birds, and to serve the Board and the people of the State in an advisory capacity in matters relating to the economic status of birds and legislation concerning them. The salary provided is $500 per annum, and the total expense allowed, including salary, $1,000 per annum.

On April 2, 1908, this Board, acting under authority of the law above mentioned, elected Edward Howe Forbush of Wareham as State Ornithologist. Mr. Forbush has been very diligent in his duties during the year. The salary of course does not entitle the State to his entire time, and he has other interests that call for much of his attention; but as his principal work is as agent of the National Association of Audubon Societies, he is practically engaged in work on birds and bird protection at all times. His election was a deserved compliment and only a partial recognition of the

great amount of valuable work which he has done without expense to the State for years past.

Three bird pamphlets have been issued by him, being reprints of articles on birds published previously in the "Agriculture of Massachusetts." His report as State Ornithologist will be found printed elsewhere in this volume.

The demand for "Useful birds and their protection," by Mr. Forbush, has continued throughout the year, though of course it has decreased in extent with the passage of time. The second edition is now almost exhausted, and we have on hand a third edition of 1,500 copies on sale at the same terms, — $1 per copy.

Massachusetts Agricultural College.

The progress of this institution has been marked during the year. There are now more students in attendance than ever before, a larger teaching force, more and stronger courses, and the appropriations from the State and national governments have steadily increased from year to year. During the year new greenhouses have been erected, the Legislature at last having granted the necessary appropriation, and the college is now in position to give instruction in this line of work in accordance with the importance of the industry in Massachusetts. Many other improvements have been made during the year, and with the steady increase of assistance from the United States government we may look for further increases from the State and greater attendance and more interest on the part of the people. Let us not forget, in the days of our prosperity, those who stood firm at the helm while the college was on trial in the early days, when the term "Aggie" was a disgrace in the eyes of most, and the college was a favorite target for the economical or humorous legislator. They were insistent then that the day of the college was coming; true prophets, their faith in her future never wavered, and they stood firm for her rights and prestige when that course was not as easy as it is to-day. We can only regret that there are so few of those who went through the trial who are alive to-day to

see the fulfillment of what they labored for; let us hope that it is given them to see with the eye spiritual, though not with the eye physical. Through all its changes and vicissitudes, the Board of Agriculture has been a firm supporter of the Massachusetts Agricultural College. To-day, as in the past, we stand pledged to work for all reasonable and needed appropriations, and to urge upon the Legislature the necessity for liberal treatment of this institution.

The Gypsy and Brown-tail Moths.

The work against these insects has been carried on with vigor, and all done that is possible to do under present conditions. It is idle to regret the past, but I cannot but again speak of the added proof of the mistake made by the Legislature which stopped the work against these insects. The expense of fighting them, now that suppression instead of extermination is sought, is greater than in the days when the work was in the hands of this Board; and, as suppression must mean gradual expansion, we can only look for relief from some parasite or fungous disease. Nothing of the sort has yet appeared which seems capable of even checking the gypsy moth; but in some sections the brown-tail moth appears to have suffered from a fungous pest which did much to decrease its numbers. The committee on gypsy moth, insects and birds made a visit of inspection to the territory, and has kept up an interest in the work. The report of this committee will be found printed elsewhere in this volume.

Crop Reports.

The monthly crop reports of the Board were issued as usual, from May to October, during the year. The special articles included in these reports were: "Potato-growing suggestions," by Dr. Chas. D. Woods; "Some sheep topics for Massachusetts Farmers," by Prof. Ray L. Gribben; "Drainage," by Prof. Wm. P. Brooks; "Artificial hatching and rearing of chickens as applied to South Shore roasters," by Henry D. Smith; "Renovating old orchards," by Prof. F. C. Sears; and "Strawberry culture," by Prof. F. A. Waugh. More

numerous requests were received for these reports than in any previous year, and the edition increased from 5,100 for May to 5,600 for September and October, as compared with 4,900 for October of 1907. The edition is exhausted for all except the report for October, a few copies of which are still on hand, and reprints of all articles will be issued when in print for the annual report. The article on drainage was arranged for at the request of one of our crop correspondents, and the instant demand for it showed that it was a timely and popular suggestion. Suggestions of this sort are always welcome, and will be acted upon wherever it seems possible.

Conference on Rural Progress.

The second session of this conference was held at the office of this Board on March 9, 1908. The attendance was so much larger than at the previous session that the conference was obliged to adjourn to a larger room. The organization and purposes of this conference have been explained in previous reports, so that nothing further need be said about them at this time. The programme discussed at the meeting was a strong one, and those present expressed themselves as very well pleased and anxious to participate in future meetings of the kind. Your secretary was continued as chairman of the conference, and Prof. Wm. D. Hurd of the University of Maine was again elected secretary.

Commission on Country Life.

This commission, appointed by President Roosevelt, and on which President Kenyon L. Butterfield of the Massachusetts Agricultural College and this Board served as a member, travelled throughout the United States, holding meetings and hearings in many centers of agricultural sections, and endeavoring to obtain as much light as possible on country conditions. Two hearings were held in New England, one at Springfield, Mass., and the other at the State House, Boston. The second meeting was called at the office of this Board, but the attendance soon compelled adjournment to Room 240, the largest room in the State House.

Your secretary was present at both hearings, and spoke on the needs of New England agriculture. The meetings were extremely interesting, and many valuable suggestions for future work were laid before the commission. I understand that the report of the commission is now completed, but it has not yet been made public. It is looked forward to with a great deal of interest by all who had an opportunity to see the commission at work and hear the matters which were brought before them. That we shall get something of value to agriculture and to farmers and their families is certain.

Publications.

The following publications were issued by this office in 1908, most of which may be obtained on application: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1907, .	662 [1]	15,000	Aug. 10.
Useful Birds and their Protection, third edition, ...	457	1,500	Sept. 29.
Crop Report No. 1, ...	40	5,100	June 10.
Crop Report No. 2, ...	40	5,200	July 8.
Crop Report No. 3, ...	40	5,300	Aug. 8.
Crop Report No. 4, ...	40	5,400	Sept. 13.
Crop Report No. 5, ...	40	5,600	Oct. 7.
Crop Report No. 6, ...	40	5,600	Nov. 11.
Nature Leaflet No. 34, ...	10	1,000	Jan. 31.
Nature Leaflet No. 35, ...	9	1,000	March 25.
Nature Leaflet No. 36, ...	5	1,000	April 27.
Nature Leaflet No. 37, ...	4	1,000	April 3.
Nature Leaflet No. 38, ...	9	1,000	April 3.
Nature Leaflet No. 39, ...	8	1,500	April 18.
Nature Leaflet No. 40, ...	5	1,500	July 23.
Nature Leaflet No. 41, ...	4	1,500	Aug. 8.
Massachusetts Agriculture, Bulletin No. 1, ...	104	1,500	Nov. 25.
Farmers' Institute Pamphlet, . .	14	800	Dec. 15.

[1] Including twentieth annual report of the Massachusetts Agricultural Experiment Station, 172 pages.

Reprints of nature leaflets Nos. 20, 26, 29, 30, 31 and 32 were also published during the year; as were new editions of Mr. Forbush's papers on "Birds as protectors of or-

chards," "Two years with the birds on the farm," and his report on "Decrease of certain birds, and its causes, with suggestions for bird protection."

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1907: "Massachusetts fruit trees and their insect foes;" "Corn as a grain crop in Massachusetts;" "Plum culture in Massachusetts;" "Hatching and rearing chicks by natural methods on the farm;" "Bee keeping: some suggestions for its advancement in Massachusetts;" "Greenhouse pests and their control;" and "Statutory bird protection in Massachusetts;" also, the annual reports of the Chief of the Cattle Bureau, the Dairy Bureau, and the State Nursery Inspector.

Legislation.

The legislation of 1908 having reference to the Board of Agriculture or to the agricultural societies was as follows: "An Act making appropriations for salaries and expenses in the office of the State Board of Agriculture, and for sundry agricultural expenses" (chapter 46); "An Act making an appropriation for exterminating diseases among horses, cattle and other animals" (chapter 44); "An Act to incorporate the Haverhill Agricultural Society" (chapter 102); "An Act to authorize the State Board of Agriculture to appoint a State Ornithologist" (chapter 245); "An Act to authorize an increase in the annual appropriation for the Dairy Bureau of the State Board of Agriculture" (chapter 416); "An Act relative to the Cattle Bureau of the State Board of Agriculture" (chapter 515); and "An Act to authorize the Haverhill Agricultural Society to hold additional real and personal estate" (chapter 430).

Legislative Appropriations: Board of Agriculture.

Objects for which appropriated.	1908.		1909.
	Appropriated.	Used.	Appropriated.
Bounties to societies,	$18,600 00	$18,271 80	$18,600 00
Salaries of secretary and clerks,	6,200 00	6,200 00	6,200 00
Travelling and necessary expenses of Board,	1,500 00	1,231 56	1,500 00
Lectures before the Board, etc.,	700 00	554 25	700 00
Dissemination of useful information in agriculture,	4,000 00	3,901 08	4,000 00
Travelling and necessary expenses of the secretary,	500 00	276 20	500 00
Incidental and contingent expenses, including printing and furnishing extracts from the trespass laws,	1,100 00	920 90	1,100 00
Printing 15,000 copies of "Agriculture of Massachusetts,"	6,000 00	5,695 68	6,000 00
Work of Dairy Bureau, including salaries,	9,800 00	9,800 00	9,800 00
State nursery inspection,	2,000 00	1,736 28	2,000 00
State Ornithologist, salary and expenses,	500 00	499 96	1,000 00
Report on "Useful birds and their protection,"	2,500 00[1]	2,496 80	–
Collecting and circulating information relating to idle or partly improved farms and farm lands,	–	–	1,000 00
Poultry premium bounty,	–	–	1,000 00
Totals,	$53,400 00	$51,584 51	$53,400 00

[1] Unexpended balance.

The Legislature of 1908 also appropriated $70,000, to be expended by the Chief of the Cattle Bureau of the State Board of Agriculture, for exterminating contagious diseases among horses, cattle and other animals; also, $14,500 for salaries and expenses connected with the office of the Cattle Bureau, including payment of inspectors of animals. There was appropriated also for salaries and expenses connected with the State Forester's office the sum of $13,000, and for the purchase of forest land and for reforestation the sum of $5,000.

Extracts from the Trespass Laws.

The demand for these printed extracts from the trespass laws was considerably in excess of that of any previous year. The record kept shows that during the year 926 individuals applied for copies of the extracts, either by mail or at the office. The number supplied individuals, on request, since the law took effect, is as follows: 1905, 2,234; 1906, 3,468; 1907, 2,439; 1908, 3,715. Prior to April 1 last, in order to comply with the law, some 980 copies printed on paper were supplied post-offices for public posting.

It is believed that these printed extracts are proving an efficient ally in the protection of private property from the unlawful acts of trespassers of various kinds and character.

As the law limits to five the number which may be supplied any one individual in any one year, and makes no provision for the sale of additional copies, it would appear that estates of several hundreds of acres when so posted cannot be adequately protected with such a limited number of copies. It is believed, however, that even a few of the trespass extracts when properly posted act as a deterrent on large estates, as well as small. Testimony given at this office would make it appear that in many cases these printed extracts are much more efficacious than the ordinary "no-trespassing" signs.

Nature Leaflets.

The following nature leaflets were issued during the year 1908: No. 34, "The first principles of bee keeping;" No. 35, "Window gardening;" No. 36, "Hotbeds;" No. 37, "How to test seeds;" No. 38, "How to plant;" No. 39, "Milk: its character and value as a food;" No. 40, "Care of milk in the home;" and No. 41, "The European elm-leaf beetle." Reprints or revised editions of Nos. 20, 26, 29, 30, 31 and 32 were also issued.

Bulletins of Massachusetts Agriculture.

A new departure in the publication line was the compilation of several lectures and papers on poultry subjects, pre-

viously published in the "Agriculture of Massachusetts," and the issuing of the same in November as Bulletin No. 1, "Poultry culture." It is purposed to continue this line of work by the issuing of one or two numbers a year; and Bulletin No. 2, "Orcharding," will be sent to the printers at an early date.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

JAN. 12, 1909.

Summary of Crop Conditions, 1908.

May closed fully up to the average, both as to work and vegetation. Feed in pastures was slow in starting. Grass in mowings was generally in excellent condition, though there was a good deal of winter-killing, particularly of fall seeding. The fruit bloom was reported as extremely heavy for all fruits except peaches, with no frosts doing damage. Very little damage was reported from insects. Planting progressed slowly, but was at its height at time of making returns. Farm help was considerably easier to secure than for several years past, with wages not quite as high as formerly. The acreage of cultivated crops, particularly corn and potatoes, was considerably increased. The acreage of tobacco suffered a slight decrease, but that of onions was slightly increased.

Insects were rather less injurious than usual in June. The acreage of Indian corn was considerably increased, and the crop, though planted late, germinated well, and was of good stand and color. Grass got a good start in May, but suffered during June from drought. Early potatoes were in excellent condition, apparently, but in need of rain. Early market-garden crops generally gave good yields, but prices were very low. The flow of milk was well maintained, and prices of dairy products were higher than usual. Feed was shortened by the dry weather, but was revived by showers in the closing days. An average crop of strawberries was secured, and other berries promised well. Peaches and plums did not set well, but there was a good set of apples for a non-bearing year.

Insects were again less numerous and destructive than usual in July. Indian corn was in excellent condition, not suffering to any extent from drought. The hay crop was

practically all secured at time of making returns, and was generally less than an average crop, probably about three-fourths. In most sections there was the usual amount of forage crops, but in the southeastern counties they were little sown, owing to the ground being too dry. Market-garden crops suffered severely from drought, with low prices. Very few potatoes had been dug, but the crop was expected to be very light. Apples promised only a light crop; pears, peaches and plums were even more unfavorable. Quinces were somewhat better; grapes set full; cranberries suffered from drought. Feed in pastures was very short in all sections. Rye, oats and barley escaped the worst effects of the drought, and were fair crops.

The promise for the corn crop was exceptional in the latter part of August. Ensilage corn was in good condition, and promised to be unusually well eared. The rowen crop promised to be very light, except on naturally moist land. Late potatoes did not promise well, blight and rot being reported, and the tubers being small and few in the hill. Tobacco was damaged by hail and wind in some sections, but otherwise a first-class crop was secured. The rains of the early part of the month brought pasturage forward rapidly, and it was generally in good condition. Apples continued to deteriorate in condition, and dropped badly. Pears, peaches and plums were light crops; quinces somewhat better, but hardly average; grapes excellent; cranberries considerably below the normal. Oats were below the normal; barley excellent as a late forage crop. Root crops are grown extensively in eastern sections, and appeared to be in good condition.

September showed the corn crop to be a remarkably good one, both for grain and stover. Rowen was a light crop in all sections, and feed in pastures was very short. The drought prevented anything like the usual amount of fall seeding being done; that sown early germinated well and was in good condition. Onions were a good crop, particularly in the Connecticut valley, the only drawback being small size in some cases. Potatoes were estimated at from one-third to one-half a normal crop, blight and early drought being the principal causes of the decline. Root crops were hardly nor-

mal, also celery, both suffering from drought; vines of all kinds did well. Apples were a light crop, small in size and prematurely ripened. Pears rather better than expected; peaches generally light; grapes a heavy crop, with no damage from frost; cranberries a light crop, with small berries and more or less damage from insects.

The final report of the season, at the end of October, showed that the corn crop was as valuable as that of any year within the recollection of the correspondents. Both grain and stover matured in excellent shape, and the high price of grain also tended to make the crop more valuable than usual. That portion raised for the silo was peculiarly valuable, as it was well eared out, and was secured practically without any damage from frost. More ensilage corn than usual was planted, and an unusually large and valuable crop was secured. Root crops were rather below the average, taking the State as a whole. They developed well and were far from being a failure, though considerably reduced in yield. Potatoes were a light crop in all sections, but brought good prices. Pastures were very dry and short during the fall, and young stock generally came to the barns in rather poor flesh. Milch cows, having been fed at the barns in most sections since early fall, remained in good condition and kept up a good flow of milk. Fall seeding done early in the season did well, but later seeding failed to germinate fully in most cases. Much less than the usual amount of fall seeding was done, owing to the unusually dry conditions which prevailed.

Prices for crops raised for market, as indicated by the returns of correspondents, averaged about the same as in former years, but the movement, if any, was in a downward direction. Of the 113 correspondents answering the question as to prices, 21 spoke of prices as higher than usual, 66 as average or about average, and 26 as lower than usual.

Concerning the question as to which crops had proved profitable and which crops had proved unprofitable, 61 correspondents, a bare majority, considered corn to have been among the most profitable crops; 53, hay; 14, potatoes; 7, onions; 5, tobacco; and 5, cranberries; while 76 correspondents, considerably over a majority, considered potatoes to have

been among the least profitable crops; 19, apples; 8, hay; and 5, tomatoes.

There appeared to be a wide variation of opinion as to whether or not the season had been a profitable one. The general opinion appeared to be that it was not a profitable season, for of the 120 correspondents answering the question as to profits, only 1 considered the season to have been unusually profitable; 14 called it an average season for profit; 18 said that it was fairly profitable; 35, that it was a profitable season; while 11 said that it was below the average for profit; and 41 flatly stated that it was not a profitable season. Some of the reasons assigned were the prolonged drought, short crops, low prices. and especially the high price of grain and other supplies.

Massachusetts Weather, 1908.

[Furnished by Weather Bureau, Boston.]

The weather of January was warmer than usual, the monthly temperature ranging from 1° to 5° above the average. The daily temperatures were generally in excess until near the close of the month, zero temperature prevailing on the 30th and 31st. The monthly precipitation was generally below the average. The snowfall was unevenly distributed through the month and over the State, in amounts ranging from 2 to 12 inches. At the close of the month there was little snow on the ground.

February was somewhat colder than the average, the temperatures ranging from 1° to 5° below the normal. The first decade was uniformly cold, but during the remainder of the month the only extremely low temperatures were on the 25th. The precipitation was generally above the normal, the snowfall ranging from 5 to 25 inches, the heavy storms being on the 5th and 6th.

The weather of March was warmer and more pleasant than usual. The temperature did not fall below zero at any time, and there were no marked extremes in either direction. The precipitation was of frequent occurrence, but the amounts were not excessive, the snowfall ranging from 3

to 10 inches, and at the close of the month the ground was bare.

The precipitation and temperature of April were below the normal, though the departures were not great in any section. The minimum temperatures occurred on the 4th and 5th. The precipitation was well distributed through the month, there being few days without measurable amounts in some section of the State. At the close of the month the season was considered somewhat later than the average.

The opening week of May was cold and unpleasant, but by the 10th the weather became warmer and generally seasonable, with sunshine near the average, and continued throughout the month, with slight exceptions. General moderate to heavy showers occurred on the 23d, and scattered local showers on several other days. The precipitation for the month as a whole was considerably below the average for the month of May.

June was exceptionally pleasant, with much sunny weather. The precipitation was deficient in about all sections of the State, while the temperature of the month was considerably above the average, the monthly means ranging from 2° to 4° above the June normal. There were no general rains during the month, the precipitation being the result of local showers and storms. At the close of the month vegetation was suffering from drought.

The drought continued uninterruptedly until the middle of July. From the 16th to the 20th, inclusive, showers were quite general, with rainfall ranging from light to copious. The rains of the latter half of the month were of great benefit to vegetation, and temporarily broke the drought. There was an unusual prevalence of sunshine during the month. The temperature was uniformly high, ranging from 2° to 5° above the normal, with temperatures above 90° on from ten to fourteen days.

From the 4th to the 7th of August there were frequent thunderstorms, with copious rainfall, which was of much benefit. Thundershowers again occurred on the 11th, 13th and 17th, with rainfall from 1 to 2 inches, in western sec-

tions. On the 26th there was a heavy rainfall in the eastern part of the State. After the 26th fair and generally clear weather prevailed. The temperature was generally normal for the first ten days, above from the 11th to the 15th, and lower after that date, the average daily temperature for the last week being from 4° to 9° below normal.

The weather of September was very dry, with temperature normal to somewhat above. There was a severe drought, beginning the last week in August and continuing until the 28th of September, when there were general showers, with moderate to heavy amounts. The atmosphere became laden with smoke and dust, and the sun was at times wholly or partially obscured. The wind movement was less than usual, and the humidity excessive. The temperatures were without marked extremes, the days being warm and the nights cool.

The conspicuous features of the weather in October were the unusual prevalence of sunshine, and the almost entire absence of rain from the 3d to the 25th inclusive. General showers occurred on the night of the 1st and on the 2d, and general rains fell on the 29th and 30th. The average rainfall of the month was, however, generally considerably below the normal. The month opened with several days of cool weather, followed by temperatures generally above the seasonal average from the 7th to the 19th. There were frosts in all sections between the 20th and 23d. The highest temperatures were generally on the 17th and the 18th, when they ranged near 80° in about all sections.

The average temperature of November was about normal, with somewhat more than the average amount of sunshine. The precipitation was very small, being a little more than half of the November average. Over the greater portion of the State the month was considered the dryest of its name on record. The small amount of precipitation caused the drought that prevailed through the summer and fall months to continue with undiminished severity. Springs, wells and streams continued low.

The weather conditions of December were without marked departures. The average temperature was slightly above the

normal. The total precipitation was between 2.5 and 3 inches. The snowfall ranged from .5 of an inch to 14.2 inches. At the end of the month the ground was generally free from snow, except in some of the western sections. There was somewhat less than the average amount of sunshine. The water supply in nearly all sections continued low through the month.

Meteorological Observations at the Massachusetts Agricultural Experiment Station.

[Latitude, 42° 23′ 48.5″ N.; longitude, 72° 31′ 10″ W. Height of barometer above ground, 51 feet; above sea level, 273.5 feet. Height of wind instruments, 72 feet.]

Bulletin No. 240. December, 1908.

Annual Summary for 1908.

Pressure (in Inches).

Maximum reduced to freezing, 30.49, February 9, 8 A.M.

Minimum reduced to freezing, 28.56, January 8, 1 A.M.

Maximum reduced to freezing and sea-level, 30.83, February 9, 8 A.M.

Minimum reduced to freezing and sea-level, 28.86, January 8, 1 A.M.

Mean reduced to freezing and sea-level, 30.044.

Annual range, 1.97.

Air Temperature (in Degrees F.)[1]

Highest, 96.0, July 12, 1.30 P.M.

Lowest — 12.0, February 5, 7 A.M.

Mean, 47.6.

Mean of means of max. and min., 48.0.

Mean sensible (wet bulb), 42.6.

Annual range, 108.0.

Highest mean daily, 80.0, July 7.

Lowest mean daily, 0.3, February 5.

Mean maximum, 59.1.

Mean minimum, 36.9.

Mean daily range, 22.1.

Greatest daily range, 49.0, October 17.

Least daily range, 4.0, November 11.

Humidity.

Mean dew point, 38.5.

Mean force of vapor, 387.

Mean relative humidity, 75.8.

Wind. — Prevailing Direction, West, Southwest. Summary (Per Cent.).

South, southwest, 9.

West, 11.

South, southeast, 9.

Southwest, 9.

South, 11.

West, northwest, 11.

Other directions, 40.

Total movement, 63.571 miles.

Greatest daily movement, 594 miles, February 2.

Least daily movement, 10 miles, October 16.

Mean daily movement, 174 miles.

Mean hourly velocity, 7.2 miles.

Maximum pressure per square foot, 30.0 pounds = 80 miles per hour, April 11, 6 P.M., N.N.W.

Maximum velocity for 5 minutes, 48 miles per hour, July 18, 12 M., S.S.W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 30.68.

Number of days on which .01 or more rain or melted snow fell, 109.

Snow total in inches, 38.5.

Weather.

Mean cloudiness observed, 41 per cent.

Total cloudiness recorded by sun thermometer, 1,711 hours = 39 per cent.

Number of clear days, 143.

Number of fair days, 130.

Number of cloudy days, 93.

Bright Sunshine.

Number of hours recorded, 2,743 hours = 61 per cent.

Dates of Frosts.

Last, June 3.

First, September 16.

Dates of Snow.

Last, April 20.

First, November 3.

Total days of sleighing, 41.

Gales of 50 or More Miles per Hour.

January 22, 53 miles; W.N.W.; 27, 56 miles; S.W.

February 2, 68 miles; N.W.; 7, 51 miles; N.N.W.

April 9, 67 miles; W.N.W.; 11, 80 miles; N.N.W.; 12, 55 miles; N.N.W.

May 2, 51 miles; S.

[1] Temperature in ground shelter.

J. E. OSTRANDER, *Meteorologist.*
R. C. LINDBLAD, *Observer.*

UNITED STATES DEPARTMENT OF AGRICULTURE, WEATHER BUREAU.

Annual Meteorological Summary of Boston, Mass., for Year ending Dec. 31, 1908.

MONTH.	Temperature (Degrees Fahrenheit). Mean. Maximum.	Mean. Minimum.	Mean. Monthly.	Extremes. Maximum.	Extremes. Date.	Extremes. Minimum.	Extremes. Date.	Relative Humidity (Per Cent).	Precipitation (Inches and Hundredths). Total.	Maximum in Twenty-four Hours.	Date.	Snowfall.	Percentage of Sunshine.	Winds. Average Hourly Velocity.	Prevailing Direction.	Maximum (for Five Minutes). Velocity.	Direction.	Date.	Number of Days with — Gales (Forty Miles per Hour or Over).	Clear.	Partly Cloudy.	Cloudy.	Precipitation (0.01 Inch or Over).	Thunderstorms.	Fog, Dense.	Snow (0.1 Inch or Over).	Maximum Temperature. 32 Degrees or Below.	Maximum Temperature. 90 Degrees or Above.	Minimum Temperature. 32 Degrees or Below.	Minimum Temperature. Zero or Below.
January, . . .	40	22	31	57	21	1	30	63	2.47	0.95	7	4.3	58	13.9	W.	48	S.W.	7	2	14	6	11	8	0	1	3	5	0	25	0
February, . . .	35	19	27	60	15	—2	5	66	2.96	0.84	19	9.3	60	12.9	N.W.	43	S.E.	1	3	11	9	9	10	0	3	4	11	0	26	4
March, . . .	47	31	39	70	27	15	10	73	2.97	0.67	18–19	4.8	53	11.5	S.W.	39	S.W.	26	0	6	9	16	15	1	2	5	3	0	19	0
April, . . .	56	38	47	85	23	24	4	73	1.70	0.39	8–9	0.8	63	13.2	N.W.	45	W.	11	1	9	11	10	15	3	1	2	0	0	7	0
May, . . .	67	51	59	88	27	39	3	76	3.78	1.83	7–8	0	59	10.9	E.	36	S.E.	30	0	9	11	11	10	0	0	0	0	0	0	0
June, . . .	80	60	70	90	8	49	2	63	1.08	0.59	16	0	80	9.8	S.W.	31	N.W.	2	0	15	11	4	7	4	1	0	0	2	0	0
July, . . .	83	65	74	97	12	58	16	71	3.17	1.68	25	0	68	9.4	S.W.	28	W.	8	0	6	14	11	7	5	2	0	0	4	0	0
August, . . .	76	63	69	90	14	47	29	73	4.35	1.96	6–7	0	59	9.4	S.W.	28	N.E.	27	0	10	10	11	9	4	0	0	0	0	0	0
September, . .	74	58	66	88	11	47	30	69	0.68	0.60	28–29	0	65	9.3	S.W.	30	S.	29	0	13	8	9	3	0	1	0	0	0	0	0
October, . . .	63	48	55	80	18	35	31	73	3.70	1.46	26	0	60	9.0	N.W.	35	N.	30	0	15	6	10	7	7	3	0	0	0	0	0
November, . .	51	36	44	65	24	25	5	70	0.74	0.47	14–15	T.	56	11.2	W.	40	W.	15	1	11	5	14	9	5	2	0	0	0	9	0
December, . .	41	26	33	67	1	10	6	70	2.47	1.10	7	3.5	49	11.4	W.	47	S.E.	7	1	10	9	12	7	7	0	3	4	0	24	0
Totals, . .	59.4	43.1	51.2	97	July 12	—2	Feb. 5	70	30.07	1.96	Aug. 6–7	22.7	61	11.0	S.W.	48	S.W.	Jan. 7	8	129	109	128	107	36	16	17	23	6	110	4

Miscellaneous Data for 1908.

Barometric Pressure (reduced to Sea Level). — Mean, 30.01 inches; highest, 30.76 inches, February 10; lowest, 29.01 inches, February 1.

Temperature. — Greatest daily range, 37°, May 11; least daily range, 4°, May 7, July 25, October 26, November 11. Greatest monthly range, 62°, February; least monthly range, 39°, July. Highest mean temperature of three consecutive days, 83°, July 5–7; lowest mean temperature of three consecutive days, 11°, February 3–5.

Precipitation. — Longest period without precipitation, 16 days, September 12–27. Longest period with precipitation, 7 days, March 13–19.

Frost. — In spring, last killing frost occurred on April 21; in autumn, first killing frost occurred on November 2.

Snow. — Greatest snowfall in twenty-four hours, 3.9 inches, February 19. Greatest depth of snow on the ground, 3.7 inches, January 24 and February 19. Last snow in spring occurred on April 20; first snow in autumn occurred on November 13.

Thunderstorms. — First thunderstorm, March 15; last thunderstorm, August 13.

J. W. SMITH, *District Forecaster.*

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE

1908.

MEETINGS OF THE EXECUTIVE COMMITTEE.

BOSTON, May 14, 1908.

The executive committee met in the office of the secretary of the Board this day, at 11 o'clock A.M.

Present: Messrs. Kilbourn, Pratt, Richardson, Paige and Secretary Ellsworth.

The petition of the Weymouth Agricultural and Industrial Society for approval of its vote to increase the mortgage on its property to $3,700 was taken up and the reasons therefor explained by Delegate Tirrell. No one appearing in opposition and the law appearing to have been complied with, it was voted to grant the petition and approve the vote.

The credential of Mr. Wilfrid Wheeler of Concord, elected by the Massachusetts Horticultural Society as successor to the late William H. Spooner, was presented and accepted.

Mr. Wilfrid Wheeler was then appointed to the committee on experiments and station work, to fill vacancy caused by the death of Mr. Spooner.

BOSTON, Sept. 15, 1908.

The executive committee met in the office of the secretary of the Board this day, at 11 o'clock A.M.

Present: Messrs. Kilbourn, Pratt, Worth, Paige and Secretary Ellsworth.

The matter of paying the bounty to the Bristol County Fair, Inc., referred to the executive committee at the recent meeting of the Board in Barre, was considered. Delegate Howard was present to represent said society.

Voted, That the secretary be instructed to certify to the State Auditor that the usual bounty is due the Bristol County Fair, Inc., based upon its fair of 1907.

SPECIAL BUSINESS MEETINGS

OF THE

BOARD OF AGRICULTURE

1908.

SPECIAL BUSINESS MEETINGS OF THE BOARD.

BOSTON, April 2, 1908.

A special business meeting of the Board of Agriculture, pursuant to call, was held in the office of the secretary, in Boston, this day at 1.30 o'clock P.M., First Vice-President Pratt presiding.

Present: Messrs. Albert Ellsworth, J. L. Ellsworth, Gerrett, H. M. Howard, W. N. Howard, Jewett, Kilbourn, Mason, Paige, Peters, Potter, Pratt, Richardson, Russell, Sagendorph, Smith and Trull.

The election of a State Ornithologist, as provided by the Acts of 1908, chapter 245, being in order, a ballot was taken which resulted in the unanimous choice of Edward Howe Forbush of Wareham.

A protest having been received from the Spencer Farmers' and Mechanics' Association against the assignment of September 24 and 25 to the Worcester County West Agricultural Society for the holding of their fair, said dates having also been assigned to the Spencer society, the matter was taken up and considered, when it was

Voted, To assign September 22 and 23 to the Spencer Farmers' and Mechanics' Association, with the understanding that this assignment be for the year 1908 only.

Messrs. Kilbourn, Potter and Secretary Ellsworth were constituted a committee to prepare resolutions on the death of Hon. William H. Spooner.

A vote of sympathy to His Excellency Governor Guild, on account of his severe illness, was passed, and the secretary was directed to communicate this action to his Excellency.

BARRE, Aug. 21, 1908.

A special business meeting of the Board of Agriculture was held at Hotel Barre, Barre, in connection with the summer meeting of the Board, this day, at 9 o'clock A.M., being called to order by First Vice-President Pratt. A quorum of the members was present.

The thirteenth semiannual report of the Chief of the Cattle Bureau was presented and read by Secretary Ellsworth, which report was accepted by vote of the Board.

Secretary Ellsworth asked for instructions in the matter of certifying the Bristol County Fair, Inc., for bounty for the year 1907.

Voted, That the matter be left with the executive committee with full power.

Mr. Wilfrid Wheeler presented the matter of investigating the proposed plan of draining the Neponset meadows, and asked that a committee be appointed to look further into the matter and co-operate with the State Board of Health and the Metropolitan Park Commission in any way possible.

Voted, That Messrs. Wheeler, Richardson, Ward, Rane and Potter be such a committee.

GREENFIELD, Dec. 1, 1908.

A special business meeting of the Board of Agriculture was held at Washington Hall, Greenfield, in connection with the public winter meeting of the Board, this day, at the close of the afternoon session, being called to order by Second Vice-President Bursley. Nearly all of the members were present.

The matter of forming a cow-testing association was introduced by Mr. J. L. Smith, when, on motion, it was

Voted, That a committee be appointed to consider the question and report at the annual meeting of the Board in January. The Chair appointed Messrs. Smith, Potter and Damon as the committee.

On motion of Mr. Wheeler, it was

Voted, That a committee be appointed to consider the control and eradication of the San José scale by amendments to the present laws. Messrs. Wheeler, Dr. Henry T. Fernald and Prof. F. W. Rane were appointed the committee.

SUMMER FIELD MEETINGS

OF THE

BOARD OF AGRICULTURE

1908.

DEMONSTRATION MEETING OF THE BOARD, AT ASHFIELD.

A demonstration meeting of the Board was held on the grounds of Mr. C. A. Bronson, at Ashfield, Friday, June 5, 1908, the following programme being carried out: —

At 10.30 o'clock A.M. Hon. W. A. Blodget of Worcester demonstrated the proper manner of grading and packing apples for domestic and foreign markets.

At 11.15 A.M. Mr. P. M. Harwood of Barre demonstrated the points of the dairy cow, and showed how to select and breed for best results, illustrated by animals of the various types.

At 12 M. dinner was served by Ashfield Grange.

At 1.15 P.M. Dr. James B. Paige of Amherst demonstrated the soundness of the horse, with instructions as to feed and care, when in use and when idle.

At 2 P.M. Prof. S. T. Maynard of Northborough demonstrated the proper methods of budding, grafting and pruning fruit trees, showing proper tools and appliances.

The day was pleasant. The attendance was estimated at about 350.

SUMMER FIELD MEETING OF THE BOARD, AT BARRE.

A summer field and demonstration meeting of the Board, in co-operation with the Massachusetts State Grange, was held on Barre Common, Barre, Friday, Aug. 21, 1908, with the following program: —

At 10.45 o'clock A.M. Mr. S. H. Reed of West Brookfield demonstrated the points of the dairy cow, and how to select and breed for best results, illustrated by animals of various types and ages.

At 11.30 A.M. Dr. James B. Paige of Amherst demonstrated the proper methods of handling and hiving bees, with observation hive, and instructions as to the best methods of keeping them.

At 12.15 P.M. dinner was served in the town hall at 50 cents per plate, some 200 being present. First Vice-President Pratt presided at the dinner. The speaking was under the auspices of the Massachusetts State Grange, with the principal address by Hon. Aaron Jones, Past Master National Grange. Addresses were also made by State Master C. D. Richardson, Dr. Geo. M. Twitchell of Maine and others.

At 2 P.M. Prof. S. T. Maynard of Northborough demonstrated the proper methods of budding, grafting and pruning fruit trees, showing proper tools and appliances.

At 2.45 P.M. Dr. Paige demonstrated the soundness of the horse, with instructions as to feed and care, when in use and when idle.

The day was very pleasant. The attendance was upwards of 400.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE

AT

GREENFIELD.

December 1, 2 and 3, 1908.

PUBLIC WINTER MEETING OF THE BOARD, AT GREENFIELD.

The annual public winter meeting of the Board for lectures and discussions was held at Washington Hall, Greenfield, on Tuesday, Wednesday and Thursday, December 1, 2 and 3. The attendance, while not unusually large, was good, and the meeting was considered a very successful one.

The meeting was called to order at 10 A.M. by Secretary Ellsworth who introduced Hon. Frank Gerrett, the local delegate, as the presiding officer. Without preliminary remarks he introduced Mr. Eugene B. Blake, chairman of the Board of Selectmen, who delivered the address of welcome.

ADDRESS OF WELCOME, BY MR. EUGENE B. BLAKE.

Agriculture of necessity was probably the oldest art of man. It was practised diligently by the most primitive people of all nations. We even read of Adam and Eve that they had a garden.

The earliest settlers of this country had to contend with innumerable obstacles in the tilling of the soil, the wildness of nature, their ignorance of the climate, the depredations of wild beasts and the Indians and the difficulty of procuring seeds and farm implements. Thus for many years agriculture was exceedingly backward. After the Revolution fresh interest was aroused. George Washington in his correspondence shows how anxious he was to promote the highest interest of the people by the improvement of agriculture. Different State societies were organized, the South Carolina in 1784, the New York in 1791 and the Massachusetts in 1792. Many years elapsed before the custom of reading became sufficiently common among the actual tillers of the soil

to justify the annual publications of the transactions of those societies. The improvements proposed fell dead upon the people, who rejected "book farming." Gradually great improvements in farm methods have been brought about, until this ancient art has been made almost an exact science.

I consider it a great good fortune for any community, in which the farmers form a large element, to be favored as we are by the meeting of the State Board of Agriculture among us this week, and I believe I voice the feeling of the entire community in giving you a hearty and sincere welcome to our midst. May your stay be pleasant, and your mission to us aid in bringing about a general realization of the fact that the power of this great United States resides really and finally in her soil.

The Chair. Perhaps you would be glad to hear a word from your secretary, Mr. Ellsworth.

RESPONSE FOR THE BOARD, BY SECRETARY ELLSWORTH.

I wish to extend to you, Mr. Chairman of the Board of Selectmen, on behalf of the Board of Agriculture, our thanks for the cordial words with which you have welcomed us and for what you have said in behalf of agriculture, which is the leading industry of the nation today. After feeding our people here at home, the amount of food sent abroad is something astonishing.

In speaking for the Board of Agriculture, I wish to remind you that the first of this series of winter meetings was held at Springfield, forty-five years ago; the second one was held here, in 1864. Since that time three other meetings of the Board have been held in Greenfield, this being the fourth. At the first meeting, in 1864, His Excellency Governor Andrew occupied the chair during the first day. He was invited by the Board to give his views on the establishment of an agricultural college and the course of study to be pursued, the subject under consideration being "Agricultural education." The next meeting was in 1879, and was called to order by your late townsman, Hon. James S. Grinnell. He

was chairman of the committee of arrangements, and in his address of welcome gave a word picture of the history and agriculture of Franklin County. The third of these meetings was held in 1896, being also called to order by Mr. Grinnell. In connection with this meeting was a large and interesting exhibit of butter.

These Board meetings have been an annual feature from the very first, the Board going from one portion of the State to another, and thus coming in contact with the farmers. Lecturers are provided by the Board for these meetings, and an opportunity is always given for discussion, so that by questions points may be brought out which otherwise might be omitted.

The agriculture of Massachusetts has not been neglected. It has been fostered by the agricultural college, the experiment station and the work of the agricultural society and farmer's club. The conditions have changed, and farmers have changed their methods. Statistics just completed, taken in 1905, give the value of the agricultural products of the State as $73,110,490. The leading agricultural industry in Franklin County is the dairy, — milk, cream and butter. I have figures to show that agriculture is on the increase in Massachusetts, not declining.

I wish again, Mr. Chairman, to thank you for your very kind welcome, and to assure you that we shall have an interesting and instructive meeting.

The Chair. The lecture to be given this morning is by Mr. L. B. Harris of Lyndonville, Vt. Mr. Harris has been in the sheep business all his life, and I am sure will be able to interest us on the subject of "The sheep industry in Massachusetts."

THE SHEEP INDUSTRY IN MASSACHUSETTS.

BY MR. L. B. HARRIS, LYNDONVILLE, VT.

Within the memory of many of us the most of the farms in Massachusetts had a small flock of sheep. They did not go out of existence as the result of any one cause, but dropped out one by one, the owners hardly realizing that their individual act was the part of a great movement. Neither did the onlooker realize what was going on. The first we knew, there were no sheep. Is it a cause for regret? Is their disappearance a loss to Massachusetts agriculture? Some of us enthusiasts in the business will, under the influence of sentiment, perhaps, maintain that the State has suffered a loss. I am not certain that such is the case, and is not the fact that all these level-headed men have dropped out of the business sufficient proof that it was for the best?

The dairy interest in the State has increased to a wonderful total in this movement. The modern dairy barn is as poor a place to keep a sheep as can well be imagined; besides, to operate a dairy to its utmost requires the undivided attention of the owner.

Again, the necessity of a flock for its wool is gone. Who of you would think of having your clothing made in your own homes, from the backs of your own sheep, as your fathers did? Few indeed have even their mittens of homespun now. The difficulties of supplying the table with meat the year around is not as great as in the olden time, so that dressing a lamb or a wether for the family use is not as necessary as then.

Although I should not dare to assume a mortgage and expect to pay it by any other means, I will not quarrel with the men who have quietly dropped out of the sheep business

in the last half-century. What everybody has done must be right; still, the Massachusetts farmer will hardly claim to be superior as a husbandman to the farmers in Holland, or claim to be a better dairyman, and small flocks of superior sheep are as thick in Holland as flocks of geese, and their low, damp fields are not as good for sheep as are the fields and hills of your State.

Our grandmothers would have thought it hard lines if they could not have had a few fleeces from which to clothe the family. I warrant you have no complaints on that score to-day, and let us grant that our way is best, although personally I cannot subscribe to that idea.

If I were to ask any of you what kind of sheep your fathers kept, you would say "Why, the old native sheep." If I question further, and ask where the old native sheep came from and what they really were, I doubt if I should get any reply at all; and it is a subject that I have never heard discussed among stock men, nor have I ever read anything that seemed to comprehend the facts.

Livingston, in 1807, said that along the Massachusetts coast there were the Narragansett sheep, but he does not tell us where they came from; probably he did not know. You will all agree that they were not descended from any of the English breeds. There were often black sheep among them, but never a black-faced sheep. They resembled the Cheviot a little, but they never had the Welsh breeding proclivities. They had as little in appearance to point to a Spanish ancestry as to the British Islands; and the Indians, except in a small part of the mountains in South America, had no domestic animals whatever. There is little known about them, and you must not place too much reliance on what I advance as theory; the facts that I bring out are matters of record, which have been translated and published in our day. I first heard the tale many years ago from the mouth of a Jesuit, while sitting at his camp fire in the great north; since then I have found confirmation of his story in the records of his order, and have personally visited the places and verified many of the statements.

About the year 1535 a small party of French men and

women determined to come to the new world and establish a colony to engage in agriculture. The French government, during its two hundred years of dominion over this country, went on the theory that the country belonged to the natives; that French subjects must not occupy the soil or engage in manufacturing; they must be content to fly the flag of France, trade in beaver skins and convert the souls of the savages to the Christian religion; so that this little party had to be secret about their movements, for if the authorities should know their purpose, they would be arrested and their ship confiscated.

They managed to fit out the ship with cattle and sheep, we know, and perhaps horses and hogs, and crossed the Atlantic with their families and all that they thought they needed to build a home for themselves and their children. They landed near what is now the dividing line between Maine and New Brunswick. Nothing is known of their fate; whether they returned to France, whether some disease destroyed them, or what became of them, no one knows, — they disappeared.

A hundred years after, a missionary, coming to Canada *via* the St. Lawrence to work among the Indians on the Great Lakes, was driven out of his course by the storms; and the sailors believed that they had a Jonah on board, and quietly gave the priest a few supplies, including a firearm, and put him ashore to die, as they supposed. The winds went down and they sailed merrily away to Quebec.

The priest had no notion of dying, but proceeded to investigate his surroundings. He soon found evidences of former inhabitants of his own race, and on the first day of his stay he shot and killed a bull that appeared upon the scene. This was upon the mainland. He soon discovered that the islands were covered with sheep, and he expressed the idea that they got there upon floating ice and by that means spread up and down the coast; that they lived and multiplied there on account of the difficulty that their enemies encountered in getting to them. He learned that the cattle and sheep had sprung from the colony at that point a hundred years before. This he gathered from things that he

found, and the Indians told him the story as it had been handed down by their old men.

The cattle were not very numerous, and soon disappeared, but the sheep have stayed on many hundreds of the islands until this day. They spread along the coast as far south as Nantucket, and it is not so very long ago that there were considerable numbers left on that island. I am inclined to think that the summer resident along the coast has driven them away, and the Society for the Prevention of Cruelty to Animals is now engaged in driving them out of the sheep's paradise of the world, — the islands off the coast of Maine, — and in a few years they will be destroyed.

On many of those islands, where there were no grass or shrubs, throve a small flock, always fat, which subsisted entirely upon seaweed. Many years ago I got a sample of the rockweed on which they seemed to do the best, and found by analysis that it was very like clover hay and almost exactly like early cut rye, the rye having a little more wood fiber.

From these islands sprang the best breed of sheep in the world for our conditions then, — the native sheep. They have covered the continent wherever sheep have since been raised, even to far-off Mexico. By in-breeding, by the survival of the fittest, they took a fixed type. A hundred years ago their fleece was nearly twice as heavy as any of the English breeds, and their meat was a third more. Of course they were very wild, their nostrils were as sensitive as those of a deer; but they took kindly to captivity when they were taken to the mainland and domesticated. In their wild state they would take to the sea when cornered, if they could, and will to this day, and will live in water in full fleece for half an hour. I have had one, when cornered in a brush corral, leap over my head and clear it by two feet to get away. Once I shot a yearling, which weighed, after being dressed and hung in the cellar several days, 78 pounds, and no mutton could excel it in eating qualities.

The title to these sheep passed with the title to the islands; some of them had several hundreds, others less, according to their size. There is yet enough of the pure native sheep to

build one of the most useful breeds of sheep in the world, if they were in the hands of a few skilful shepherds who would act together; but the society heretofore mentioned, and the lack of fighting qualities in their owners, have doomed this most useful animal. He has done his work; for hundreds of years he has furnished the foundation for all our sheep. We cannot estimate the wealth that our "native sheep" has brought us, but no one has written his history.

This discussion, however interesting, is not what we are called together for, it is rather to learn what sheep can do for the poor man who has his living to make and his children to bring up on a cheap farm in this State. The rich man needs no sheep.

In this article I will confine myself to telling you about a man whom I know, and about his methods. In the first place, he liked sheep; whenever anything came up, he knew what to do with his animals, and without this gift you cannot succeed, try as you will, — the business will go wrong unless you are a natural sheep man. A good shepherd is like a poet or a fisherman, — he must be born that way. With cows or horses or pigs it is different, — you may acquire a knowledge that will be fairly successful; but with sheep your instincts must tell you what to do. One of the most successful horse breeders that I know closed both doors of a freight car upon a flock of pure Shropshire sheep, and left them for some hours. Although none of the sheep died, none of them would ever thrive afterwards. They had better have been dead. I knew another man of considerable experience who ruined a very good lot of sheep by shutting them up in a close cow stable from Sunday afternoon until Monday morning. The born shepherd would never do those things.

It takes more knowledge and less work to raise sheep successfully than any other live stock. The man that succeeds has, first, a bright-looking flock; the appearance of the wool itself tells the story as far as the sheep can be seen. They are quiet, also. You cannot have a good sheep and a nervous, wild sheep in the same animal. He must have size, and plenty of room for his dinner as well as his heart. The dam

must be a good milker; you cannot raise lambs without good mothers. The ram must be strong and masculine; you cannot have a pinched-up flock that will average 60 pounds, and do any thing with it. Perhaps the most essential thing of all is to have a good milker.

But to return to our example: he had little money, and could not get a farm well located; so he bought a cheap one, almost an abandoned one, the buildings somewhat out of repair, but good hill land. He was to pay $1,700 for it. He had a brood mare and 2 cows; he then bought 90 aged ewes, as good as he could find, not being afraid of an old ewe if it showed signs of being a good breeder. He did not agree with the newspaper editor, who says cull out the old ewes every year; he knew that the old ewe was the best breeder, and would be most likely to bring him twins and know how to take care of her lambs.

He sowed 6 acres of oats and let them get dead ripe, and stored them in his barn without threshing. He planted an acre of turnips — ruta bagas — and an acre of corn, and he sowed 6 acres of rape; his rape was in the back side of his mow field, in a rough, wet place that he could not get ready until June 20, but it was good land, and he put all the manure on it that he could get. He used 3 to 4 pounds of seed to the acre; 1 pound would have done as well, or 20 pounds would have done no harm; it would have been better, perhaps, if he had sown in drills and cultivated twice.

When fall came, and the feed began to get short in the pastures, he turned his whole flock into the field, but fenced out the rape and the turnips with temporary fence. When the feed got short in the field, and the frost came, he turned the ewes back into the pasture and let the lambs into the rape, giving them the run of the field and the rape, keeping always a box of salt near the rape, in case a sheep should get too much rape; though in practice I have never known a case of that kind, and I have fed rape without limit for a quarter of a century.

This brings us to what is, in my opinion, the most important part of our subject, — the cultivation of rape. I have been talking sheep in some States for many years, and

as I go over the old routes again I can see but meager results for my efforts, except in this, — that quite often some one comes to me at the close of a meeting and says, in effect, "I began the raising of rape after you urged it at such a time, and have kept it up ever since, and it has done for me all that you claimed for it;" and, while I will not say to you that it is best for you to go into sheep, I will say most emphatically that if you raise sheep you must raise rape or its equivalent. You may use thousand-headed kale or curly Scotch kale, but you must raise something to finish your lambs with, to take the place of grain. Rape should be good up to the market time for Christmas. It matters not if there is a foot of snow, the lambs will get every particle of it; and experiment has shown that no feed, however rich, no feeder, however expert, can make a lamb grow equal to rape, with the animals running on the ground where there is some little roughage, like frost-bitten second crop of grass, or access to corn stalks, oat straw or anything of that sort. Lambs so fed will gain more per day and will stand a long shipment before killing better than grain-fed lambs. You will readily see the great saving in cost at the present prices of grain, also a saving in health and loss from heavy feeding.

But let us return to our example, who had turned his entire lamb flock upon rape. He let them run until time for the Christmas market, when he notified the local drover to come and see his lambs. The drover told him to go over the flock and sort out the culls, and the next morning he would come and buy those that were fit to go. The next morning he drove the lambs to the barn, and this was the first time that they had ever been confined under a roof. The buyer came and supposed that the lambs had been sorted, as there were no culls, and bought the whole lot at 6½ cents per pound, to be weighed at the cattle yard the next Monday, ½ a cent above the highest quotation in Watertown; and when the lambs were weighed they made 98½ pounds each. His ewes sheared 7 pounds to the fleece, and he received 26 cents per pound, — his ewes had earned for him $8.22 each. His flock had earned for him $739.80. His brood mare had raised a foal, there had been a little income from the two

cows, and he had a pig and considerable poultry. He had not, nor did he that year, buy any grain.

He paid the interest on his farm debt, paid for the 90 ewes and bought 10 more, as the result of that year's work. He had worked out in winter enough to pay for the help he had in haying and harvesting and in breaking his ground.

That was thirteen years ago; he has each year kept his ewe flock up to 100, and he has repeated the process, except that he has improved the farm, and now has 15 cows and some horses and colts. Long ago he paid for the farm, and has rebuilt his buildings.

And that brings us to the matter of buildings. Had our friend been less of a genius in sheep husbandry he would have given up the idea of sheep at the outset, for there was no place on the farm in which to winter them. The little, dilapidated barn could hardly hold his cows and horse when the hay and grain was stored. He knew the essentials for sheep cover for winter, — that is, plenty of light and air, out of a draught, and a dry place to lie.

With some old lumber and some brush he built an ideal place against a retaining wall below the road and reaching out from the barn, where the ground was dry and water ran from the shed. He put some dry bedding into his shed early, and, though the whole front was open, it did not freeze all winter.

He built no feed racks or troughs, nor has he until this day, feeding the hay and mowed oats on the clean snow, enlarging the circle each day until a storm came, when he began over again at the front of the shed. He raked up all the oats each day and fed them to the colts. He fed his turnips whole upon the snow, and no waste occurred. Sheep feed far better that way than in racks, eating their rations much better than in any other way.

He sheared his own sheep, and he learned to dress a fat one in good shape. If he had a fat sheep to kill, he shut it up the night before, where it could get nothing to eat, so that any bad taste or odor from the undigested food would be impossible; then he would hang the carcass in a dry cellar, and would cut from it for family use until it was used up,

looking out that all wet places were open to air and light. In cold weather mutton will keep indefinitely, if the room is dry, — temperature matters little; if it is dry enough so that bread will not mold, mutton will improve each day and week.

He never used expensive rams, but most often those descended from the Canadian coarse wool, a most excellent sheep for lamb raising, keeping in view, when selecting his rams, quality coupled with fair size, rather than an overgrown animal.

In winter he fed his ewes twice daily, once on hay — being careful never to feed timothy — and once on his mowed oats. When these are ripe the loss from shelling is almost nothing, and they eat it pretty nearly clean, too; the grain being ripe, the oat stem or peduncle is tough and fibrous and will not break easily; again, the feeding quality of the oats seems better when ripe and unthreshed. I have followed the practice, and have never experienced any loss from shelling or from mice. Towards spring he began to feed his turnips, — whole always to a full-mouthed sheep, unless you have to make a feed of straw or corn stalks, then you can cut them both and mix to advantage; always cut turnips for lambs, — they do not have teeth to slice them with.

He never gave water to his sheep, — and a sheep will die quicker for want of water than any domestic animal that I know; but our man had no yard, even, his shed opened into the pasture, so that in winter they always had access to clean snow. Unless sheep have been educated to drink water, they will eat snow in preference; but let the snow be the least bit dirty or foul, and they will not touch it. You will readily see that the question of water is important; unless your sheep have a clear run, they must have fresh water at all times.

Let us look over the essentials: they must have a dry place to lie in; they must be out of a draught (a tight board fence is better than a barn cellar); they must be fed at exactly the same time every day, — whether you feed once, twice, three of four times a day matters little. I feel inclined towards twice a day; but do not vary the time, — if you can't feed

regularly, don't keep sheep. Our sheep care nothing for cold or storm or rain, if the other conditions are lived up to.

We have been discussing sheep from the standpoint of a middle-wooled sheep, because the most if not all are of that breed in this State, many of my remarks would be very much out of place in talking about coarse-wooled sheep or the merinos. The rearing of coarse-wooled sheep, although profitable and interesting to a wonderful degree, is not likely to be taken up in this State, — in fact, I would advise you to buy no sheep whose wool will part on the back in a long, cold rain; if it will, you must put the animal under cover whenever a storm comes, while one that will not part under those conditions will never need cover, and if it ever runs at the nose, it will be from shutting up in some warm place, where it should never be.

We have said nothing about the raising of pure-bred sheep, for, while this field is large and can be made very profitable, the man likely to go into that needs no hint of ours.

Neither have I discussed the relative merits of the different breeds of sheep. I used to think that there was but one breed of sheep, and for me there is not; but I have been beaten so many times, and seen my favorite beaten by every breed under the sun, that the conceit is all taken out of me. There is no best breed; the sheep you like and the sheep best suited to your conditions is the sheep for you to breed.

There is another side to the sheep question. Toil as you will, use all the care you can, yet some disease may come along, some parasite too small for the human eye to see, perhaps one that the wisest veterinary knows nothing about, and your sheep die on your hands. You know no remedy, you can only struggle with what seems an unseen and relentless enemy. Use all the care you are master of, when bringing strange sheep into your flock, to get only healthy ones. It is not a bad plan to dip all sheep that you get from outside, and your lambs should be dipped each year directly after shearing the dams.

To sum up, you must raise rape, you must give the flock

air and light, you must feed at stated times, and you must have thrifty dams; with these, if you are a good shepherd, you should succeed.

QUESTION. How early should rape be put in?

Mr. HARRIS. You can be sure of a good crop if you put it in about June 15.

QUESTION. How many sheep will an acre of rape probably keep?

Mr. HARRIS. I don't know. Suppose you had a flock of sheep that you hadn't been feeding rape during the season, when the time comes to feed rape they haven't the rape appetite. You must raise your rape with the idea of feeding your sheep after the flower of feed is passed; when the green grass is gone, then have rape to turn them on. I do not advise turning the sheep in early in the season. I always keep a box of salt in the pasture.

I have a leg of mutton here that never was under a shingle until it was dressed, and never had a mouthful of grain of any kind. I doubt if there ever was a better leg of mutton shown to an audience or any person. It is good enough for anybody.

QUESTION. Did you kill it?

Mr. HARRIS. Yes. If I took this leg of mutton and hung it on a hook anywhere in this hall, after about eleven weeks it would lose that taste which clings in the roof of the mouth.

QUESTION. Which would be preferable, to have it hung in the cellar or in a dry room upstairs?

Mr. HARRIS. If the walls were damp, the mold would bother you; but take a cold room, where it wouldn't freeze, — never put it in a refrigerator, but take care of it in the open air. Suppose you hang it in the cellar and it gets covered with mold, it hasn't hurt your mutton any.

QUESTION. Any possibility of its freezing in this season of the year?

Mr. HARRIS. No; I don't think so.

QUESTION. How can you secure it from rats and mice?

Mr. HARRIS. I never have any trouble from rats or mice; of course there are cats on the farm.

QUESTION. How early should the lambs come?

Mr. HARRIS. I like to have my lambs come in January; I can get a better lamb.

QUESTION. Do you have a warm place for your sheep?

Mr. HARRIS. A good open shed to the south; plenty of bedding. I never lost a lamb in that way.

QUESTION. Do cows eat rape?

Mr. HARRIS. Yes; but let them eat it within an hour or two before milking, and you will get a very strong odor in the milk.

QUESTION. Give a description of planting.

Mr. HARRIS. I plant my rape broadcast. My advice is to cultivate it with a horse cultivator. I plant it the same distance as corn. It is easily cultivated.

QUESTION. How early in the season can you cure it?

Mr. HARRIS. Have your rape come early in November or December. You want it to take you well into the winter; let it take the place of meal.

QUESTION. How do you keep your pen dry when the sheep come in wet?

Mr. HARRIS. They never come in wet, — they stay outside. Sheep will lie, from choice, in the open.

I entirely omitted to speak of the handling of the manure of the sheep. It is a notion among New England farmers that sheep run a farm down. If you will get out the manure from the open sheep shed and pile it up, then after three or four days put it on the ground, you will save fertilizing your land.

QUESTION. Can sheep and cattle run in a pasture together?

Mr. HARRIS. I have a pasture where I run cattle, horses and sheep together, but it is a very good pasture. I shouldn't advise it in close quarters, but if you have room enough they will do well together.

QUESTION. Can you keep sheep in the same pasture year after year?

Mr. Harris. Yes; I think a good many pastures in New England do.

Question. What inducement is there for a man to go into sheep husbandry, with the present price of wool?

Mr. Harris. You mustn't place too much stress upon wool at present; mutton brings a good price, and wool is high sometimes.

The Chair. I do a little in the sheep business; it is one of the side issues. I do not know that it has been very profitable, one year with another. Mr. Harris is in one line of business, and he has talked to you about another. He doesn't tell you about those high-priced sheep he is going to get money from.

Mr. Harris talked about keeping his sheep in open sheds. He has been in the business a great many years and has many valuable sheep, and he has already made a success of it. My experience has been that sheep should not be out in the open; and if I got lambs that came in December or January, I never for a moment should think of having them come in an open shed.

Mr. C. D. Richardson (of West Brookfield). We have kept over 40 sheep in the same pasture for years, and I do not know when we have had a better flock than at present. I have not been in the habit of feeding grain, but give skim milk. I find this brings the lambs along in good shape.

Afternoon Session.

The meeting was called to order at 2 p.m. by Secretary Ellsworth, who introduced Mr. John Bursley of West Barnstable as the presiding officer of the afternoon.

The Chair. It is a pleasure, I assure you, to be present with those who are interested in agriculture. Your presence here this afternoon assures me that you are interested.

I take pleasure in introducing to you Prof. F. C. Sears, professor of pomology at our Agricultural College, who will talk to you on "The planting of a commercial orchard in Massachusetts."

Professor Sears. It is my usual custom to talk offhand,

or to talk from notes. I usually find it easier to get at the subject in that way, but I find you require a prepared paper.

There is no section of the country where the people are better able to buy good fruit than right here in Massachusetts, but to sell that fruit at the right price we must overcome the reputation that Massachusetts fruit unfortunately has. Last year in the experimental orchard we had some fine Baldwins and Greenings. We had a man pack them in boxes, and sent them to Boston at considerable expense, some 40 or more boxes. The salesman went to eight or ten high-class fruit stores with the fruit. They asked where it came from, and when told it came from western Massachusetts, they did not want it. They said their customers wanted Oregon apples, because then they knew what they were getting. A party told me this year that he had no difficulty in disposing of all his Baldwins at $5 per barrel. He had overcome the fact that he lived in Massachusetts. Every one can start out and make as good a reputation as this man. It is the man sending in the poorly packed apples who brings the market down.

In Nova Scotia ten or a dozen of the best growers averaged for four or five years, which allows for the off years, a profit from $14 up to $20 per acre on their orchards. I do not believe there is much land here in Massachusetts which yields a value of $10. There is no reason why we cannot make as good a profit as they do there. They did not sell at extremely high prices, and yet they made an unusually good profit.

THE PLANTING OF A COMMERCIAL ORCHARD IN MASSACHUSETTS.

BY PROF. F. C. SEARS, AMHERST, MASS.

I presume it will come as a surprise to most of you when I say that I propose to make my own experience the basis of my remarks to you this afternoon, because a "professor" is not supposed to have experiences, but is expected to speak from a purely theoretical standpoint. However, perhaps some of those present are aware that the past spring Professor Waugh and I started a commercial orchard in South Amherst, a few miles from the Agricultural College, and it is about our work in this orchard and the problems which we have encountered and solved that I want to tell you. I trust you will pardon the personal pronouns that I shall be obliged to use, for, when all is said and done, it is what we have ourselves actually done, not what we have seen others do, or think ought to be done, which gives our opinion weight.

Stated briefly, our undertaking is as follows: we have purchased 150 acres of land, upon which we set the past spring some 5,500 trees, — apple, peach and plum, and we have ordered for setting the coming spring about 8,000 trees. Now, I mention this not to boast of the size of our project, but that you may have an idea at the start of what we have done and are planning to do; for while you may question our judgment, you will at least see that we are willing to take our own prescriptions, which is not always the case when doctors prescribe.

To begin with, may I suggest one or two considerations which led us to go into commercial orcharding, and to undertake it on the lines we have adopted. Of course we have both of us always had a strong belief in the business of grow-

ing fruit, else we should not have adopted horticulture as a profession; and personally I believe that there is no better country in the world than right here in Massachusetts in which to engage in the business.

In the first place, Massachusetts can grow fruit of the very highest quality. We can't grow as good Ben Davis as they can in Colorado and Missouri (and personally I wish that we would stop trying to), but no country in the world can beat us on Baldwins and Greenings and Hubbardstons and a dozen other similar varieties, if we will only take care of our orchards. And while in the past anything has sold that was red and had the shape of an apple, yet as competition increases, and as people become educated up to an appreciation of what an apple ought to be, quality is going to count more and more, and Massachusetts will have more and more advantage, if she will only take it.

In the second place, we are right in the midst of the best markets in the world. There are 23,000,000 people within a radius of 300 miles from the spot where we now stand, and no equal number of people anywhere on the globe has a larger proportion who spend money freely for just such necessary luxuries as fruit.

But this nearness to markets is both an advantage and a disadvantage. It is an advantage, because we can get our fruit to market cheaply and quickly, and when we come to compete with Oregon, we ought to have the difference in freight and express as a lever on our side. But it is also a disadvantage, because we are so close to those markets that every man in Massachusetts who has a barrel of windfall apples sends them to market, in the hope of getting something for them; and though he usually realizes on this hope, yet sometimes he doesn't, and in any case, whether he gets anything out of it or not, he gives a "black eye" to Massachusetts fruit in general which it is often difficult to overcome. One of our greatest needs at the present time is to devise some scheme to keep poor fruit out of the market. Of course the ideal remedy for this is not to grow poor fruit, but until we arrive there, what are we to do?

In the third place, we took up orcharding on the scale on

which we did, because we believed that that was the way to make it pay. I have repeatedly said, and I want to take this occasion to say again, that I do not believe fruit growing in Massachusetts could be given a greater impetus than by inducing 50 or 100 men throughout the State to plant from 10 to 100 acres of orchard. The trouble with our orcharding is, that it is usually a mere side issue to the general farm work. As Professor Bailey has said, "Men do not grow their crops of apples, they discover them." But when men go into the business of orcharding more largely, making it their principal line of work, then the orchard becomes an object of pride and care; it is no longer compelled to compete with the cows and the bugs and the hay crop, but is sprayed and cultivated and pruned and fertilized for its own sake. But in urging this desirability of large-sized plantations I wish it distinctly understood that I am well aware that it is sometimes overdone, — that men plant out acres of orchard where they should plant square rods. But for every orchard that is neglected because it is too large, there are hundreds which are neglected because they are too small. It is very difficult for any man to become enthusiastic over a dozen Baldwin trees up in the back pasture, which every alternate year give a few barrels of wormy apples; it is impossible *not* to become enthusiastic over a 10-acre orchard which is every year the best paying part of the farm operations.

I might go on to cite cases where men have made comfortable livings out of small orchards and have become well to do with larger ones; for it has certainly been my observation that in those sections where orcharding flourished as a business, — where, as some one has said, it is an industry and not merely an incident, — there you will find the most prosperous farmers and the best farm homes. I say I might go on to discuss this phase of the question, but I shall pass that over and proceed with the real subject which I want to discuss with you, — the planting of a commercial orchard; or shall I make it personal, and say, the planting of *our* commercial orchard?

And first just a word in regard to the soil conditions which confronted us; for in any orchard proposition this is

one of the big questions, much more so, I think, than in general farming.

The land which we were setting was all of it badly run down. A large part of it was old sheep and cow pasture, which had been pastured for years without any return of fertilizers. One section of it had been cropped alternately with potatoes and rye until the rye had failed to reach knee-high, when it was planted out to "orchard." The trees of this section of "orchard" are now on the brush heap, and this land will be given a year or two to recuperate, and will then be replanted to *real* orchard. In one part of the old pasture, which was plowed up and planted with squash the past spring, only two patches made a satisfactory growth and gave a good crop of squashes. One of these patches was in a corner of the field, and the other was an irregular section near the center. Inquiry elicited the information that the corner patch was where the bars to the pasture were located, and where the cows gathered at night before being driven home. The irregular patch in the center was where several trees had stood, under which the cows gathered for shade. These illustrations will serve to show the condition of the land, so far as past management, or rather mismanagement, was concerned. But naturally the land was an ideal orchard soil, a gravelly loam with rather a porous subsoil; just the type of soil to give a reasonably good growth to the trees, and high color and quality to the fruit. Furthermore, a number of old apple trees on various parts of the farms were making a sturdy, healthy growth, in spite of all the different kinds of neglect which the owners could heap upon them. It was for these reasons that the location was selected, coupled with a firm belief that the fact of a soil being run down is of comparatively little moment, provided it is naturally a good orchard soil, and provided also that the owner purposes to see that plenty of plant food is supplied to the trees from the start, — two extremely important provisos.

The land for setting this first season was plowed as early in the spring as the soil was fit for working, and was then thoroughly fitted, using a disc harrow, a spring-tooth and a smoothing harrow, and finishing with a planker. This left

the surface smooth for laying off the orchard and setting the trees, by no means an unimportant item. After the trees were set, which I shall speak of more in detail in a moment, the land was kept thoroughly cultivated until time for sowing the cover crop, about July 10. There was always a team at work in the orchard, and sometimes two of them. And, notwithstanding the fact that we had one of the driest seasons within the memory of the proverbial oldest inhabitant, and the further fact that our soil was shy of humus (an extremely important factor in holding moisture in the soil), there was never a time throughout the season when the soil was not as moist as could be wished just under the dust mulch. It was certainly a striking indication of the value of cultivation. As soon as the trees had been set, an ounce of nitrate of soda was scattered about each tree; while basic slag at the rate of 400 pounds per acre, and sulphate of potash at the rate of 200 pounds per acre, were applied a little later. The result was that nearly all of our trees gave us an entirely satisfactory growth this season, in spite of the past neglect of the soil. The apples grew from 1½ to 3½ feet, and many of the peaches as much, though, being on a drier soil, they did not average as much as the apples.

This matter of fertilizing is one which we intend to follow up, for I am firmly convinced that it is a very important factor in success with orchards. I believe there is as much difference in quality between a well-fed apple and one which is grown on poor, run-out soil, as there is between a beefsteak from a well-fed animal and one from a half-starved beast. I am convinced that this is one of the important reasons why the western apples, grown on virgin soils, as most of them are, have so much more attractive an appearance than much of our eastern-grown fruit. An instance bearing out this idea came to my notice on our farm this season. One of the farms bought had a small Baldwin orchard of 1 acre (adjoining the patch where the rye and potatoes were grown), and also some scattering Baldwin trees about the buildings, one of which stood just by the hen yard, and where the ashes from the kitchen stove were dumped. The fruit from this one tree was as different from

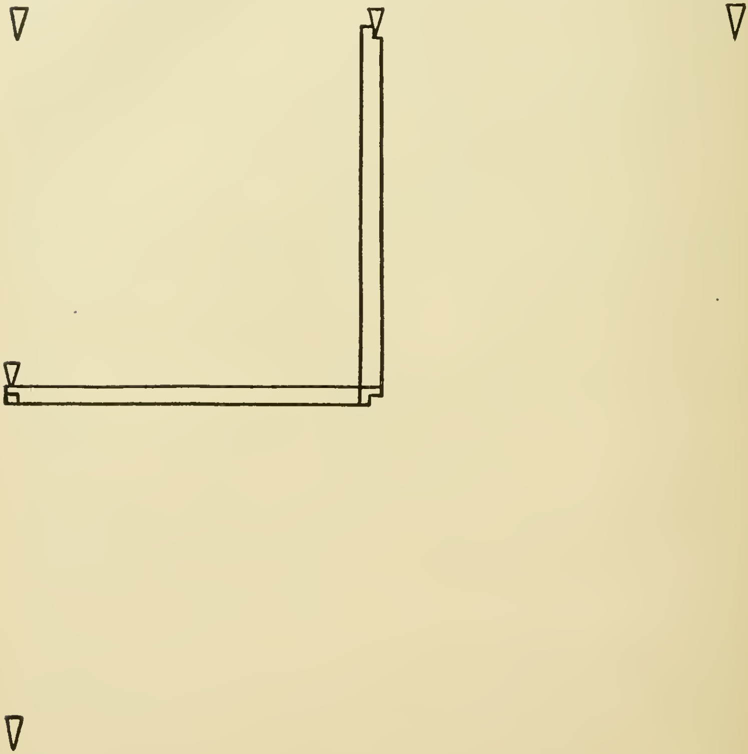
the rest as a Texas steer is from a Shorthorn. It had quality to it, — looked like the Oregon Spitzenburgs, — while that across the road was the usual uninviting type of Baldwin too often seen.

Another point which we intend to insist on is giving the young trees a balanced ration of fertilizer from the start. I believe that a very common mistake is made by assuming that the young tree needs only nitrogen for its growth, and that not until a tree comes into bearing is there any necessity of applying either potash or phosphoric acid. So long as our young trees are as big as Smith's of the same age, we are content, — mere bigness apparently being the only thing desired; whereas, if our trees got more potash and phosphoric acid from the start, they would far sooner turn from wood growth to fruiting. This, I am obliged to admit, is largely theory, but it is a theory in which I firmly believe and on which I intend to act.

One other point before we leave this matter of fertilizers, and that is, the question of lime. I am satisfied that this is another line of orchard fertilization which is altogether too thoroughly neglected. It has been my observation that the very best fruit lands are those which have in them a large percentage of lime. It gives a sturdy, stocky growth to the trees, and a high color and fine quality to the fruit. We are therefore planning to give it a prominent place in our list of fertilizers, and have already taken up the question of where we can get it and in what form we shall apply it. There are four different forms in which it can be had: first, air-slacked lime; second, fresh-burned lime; third, hydrated lime; and fourth, ground limestone. Of these, we have decided on the second, fresh burned, as the best for our purposes. It will cost us less than any of the others ($3.50 per ton at the kiln, or $6.50 per ton laid down in Amherst), and I believe for our purpose is better than any of the others. It comes in small lumps, from the size of a pea to that of a marble, has no dust, and can be scattered from the wagon with a scoop shovel; it also contains the lime in its most condensed form, and we therefore get most for our money. We shall use a carload of this the coming season, applying

at the rate of 1,000 pounds per acre, and I shall be greatly disappointed if it does not prove a paying investment.

A great deal of care was exercised, in laying off the orchard, to have the rows straight in all directions, and I should like to emphasize the desirability of this point, in



my opinion. It is often, in fact usually, neglected. Men will lay out a henhouse, which is to stand for perhaps half a dozen years, and every corner must be perfectly square and every post perpendicular; but an orchard, which is to stand for two or three generations, is laid off with a plow, or the trees are stuck into holes dug at random. To me, the satisfaction of having good straight rows is worth ten times over the added cost of making them so, which, after all, is not great. We laid off our first row with a transit, because one happened to be available, but a man with a good "straight eye" could have done nearly as well. This first

row was run along one side of the field to be planted, and a stake was set every 16½ feet, the distance apart for the trees; then a cross row was laid off at right angles to this, near one end of the field. This was all the sighting that was done. The rest of the stakes were set with two measuring boards 16½ feet long, with a small notch at either end. (The accompanying diagram will serve to illustrate the method.)

It was surprising to see how accurately and expeditiously the stakes were set, and it did not require high-priced labor to do it, either. Two Polanders, at $1.50 a day, one of whom could speak scarcely a word of English, did the whole thing; and we should be glad to compare results with anybody who has used a different method, for we feel decidedly proud of the way our trees "row" in all directions.

For locating the trees we used a planting board, a device by no means new, but which deserves a wider use than it gets. There are several types of them, but the one we used was about 4 feet long by 8 inches wide, with a notch at each end and one in the middle (see diagram). The middle notch

was placed against the stake set for the tree, a short piece of lath was then driven down in each of the end notches, the planting board was taken away, and the hole dug for the tree where the center stake stood. Then, when it came time to set the tree, whether it was that afternoon or the next day or the next week, the planting board was put in place on the two small stakes, the tree was slipped into the middle notch and was planted, and of course stood exactly where the original stake stood. Both of these methods — the setting of a stake for each tree and the use of the planting board — have been objected to by those who profess to know about such things, on the ground that they take too much time; that they are slow and expensive methods. But when I say that it cost us just 6 cents per tree to set our standard apples, which we planted first; and 5 cents for

the peaches, which followed; and that we got the price down to 4 cents per tree on the dwarf apple trees, which were the last set, — I think you will agree that it was not an exorbitant price. This included plowing and fitting the land, staking it off, digging the holes, trimming the tree and setting it out; and the difference in cost was largely due to the fact that the gang of men setting the trees became more familiar, each with his particular part of the program, and consequently could do it more expeditiously.

The field operations in setting were carried on as follows: a gang of eight men and a foreman were used; the foreman and one man went to the place where the trees were heeled in for a supply of trees, which were prepared for setting by pruning back the main roots considerably and packing them into two oil barrels, partly full of water, which were fastened on a stone boat drawn by one horse; while this was going on, the rest of the gang were setting stakes and digging holes. When the trees arrived on the scene the whole gang went to setting, the foreman distributing the trees and the eight men dividing into pairs, one of whom set the tree while the other shovelled in the earth. About 150 trees were carried at a load, and when these had been set out the gang divided as before. In this way the operations went like clockwork, and the trees arrived at the holes with their roots thoroughly soaked and in the best possible condition to take hold and grow. And that the method was satisfactory from the standpoint of the trees is pretty conclusively shown from the records of the number that grew: out of 530 dwarf apples set, we lost 14; of 250 Hubbardstons, 6 failed to grow; of 500 Wealthy, 3 died; and of 650 McIntosh, only 3 died. This is a remarkably good record in percentage of living trees, even for a good season, but in a season like that of 1908, when crops of all kinds suffered severely, I think it demonstrates conclusively that our methods of planting were sound, not only theoretically but practically.

After the trees were set, the next matter was the question of height of heading; and on this, as on several other matters, I presume it will be generally considered that we have pronounced ideas. Nearly all of our trees were headed at

18 inches from the ground, — all of them, in fact, except the dwarf apples, which were headed at 12 inches, and a small section of peaches, which we headed at 6 inches; and we have been so much pleased with the growth of this 6-inch block, that, unless we get some new light on the subject, a large part of those to be set in 1909 will be headed at this height. They have certainly made a beautiful growth, and are shaping up into fine trees. To head in this way it is almost imperative that one-year trees be set. We used one-year trees the past season, whenever we could get them; but as the enterprise was started late, we had to take two-year trees of some varieties, and invariably the one-year tree outgrew the two-year. This is very natural, since the "shock" from transplanting (if we may call it that) would be greater with an older tree; and in our scheme of low heads, when the one-year tree is cut back to 18 inches we still have strong, vigorous buds for growth; while in the two-year trees the buds are all two years old on the trunk which is left, and do not push nearly so vigorously nor so evenly as on the one-year trees. It seems to me that practically all the arguments are in favor of the younger trees, and I should use them even if I were heading higher.

So far as the question of the low head is concerned, it seems to me that practically every argument is in its favor except the one of convenience in cultivation; and this can be gotten around by having orchard tools which can be spread out, so as to work some distance on either side of the team. A disc harrow, or any other, which is in two sections, can be separated so as to work well under the trees while allowing the team to pass by without injuring them; and, though some hand labor will be needed, the cost of this will not be one-tenth what will be saved on the other operations of the orchard. In pruning, spraying and especially in harvesting the crop, the argument is all on the side of the low trees; and in these days, when we either have, or must soon expect to have, the San José scale in our orchard, we cannot afford to neglect any measure which will help us in the fight.

I am aware that in discussing the question of varieties I

am taking up a very personal matter, — one on which men differ as radically as they do in politics; but it is also one in which everybody is deeply interested, and on the proper decision of which depends, to a great extent, the success of the plantation. In what I shall say I am not pretending to dictate or even advise any one else, but am merely giving my personal views and experiences, as I have in the other matters discussed.

I believe, first and foremost, as I have already suggested, that varieties for setting here in New England ought to be of high quality. I do not believe that we should set anything poorer in quality than a Baldwin or a Greening, and I wish that a great many trees might be set of varieties very much better in quality. But in saying this I am quite well aware that under present conditions, and with present methods of growing and handling apples, the Baldwin, and even the Ben Davis, may be the most profitable varieties to grow; for a McIntosh or a Spy will not stand the treatment that the great bulk of the apples grown here receive. This is an unfortunate condition of affairs, and ought to be remedied, but at present I believe the statement accurately depicts the situation.

As to the number of varieties which a man should set, that depends very largely on the type of market for which he is working. If for the general market, then the fewer varieties he has, the better. Two or three, say Baldwin, Greening and Hubbardston, would be the limit; and many men think that they make more money out of a single variety, especially if that variety is Baldwin. I am inclined to believe, however, that for the sake of cross-pollination there should be at least a few rows in the orchard of some other varieties, even in orchards which are catering to the general market; by which is meant, of course, where the owner sells his crop at the orchard to a buyer, or ships it to a commission man.

On the other hand, if a man is working for a special or personal market, — that is, if he is supplying regular customers, either directly or through some retail fruit dealer, — then it is perfectly legitimate for him to grow a much longer list of varieties; in fact, it is necessary for him to do so, for

he does not want to drum up trade for his Wealthies and lose it when Hubbardstons are in season, only to work it up again for his fancy Baldwins or his Spies. He wants a succession of varieties, from the earliest to the latest, and for this purpose he wants from six to a dozen varieties. This is the type of trade which we hope to capture, and we are therefore setting a fairly long list of varieties.

Another question, to which we have devoted a good deal of thought and some experimenting, is the matter of cover crops. It is of course out of the question for us to use barn manure for our trees, and we do not wish to continue buying nitrate of soda any longer than is necessary, so it is imperative that we get a rank-growing, nitrogen-gathering crop, to supply us with humus and nitrogen. We used this year cow peas, soy beans, summer vetch and buckwheat. Of course this last does not add nitrogen, but otherwise is an excellent cover crop, and one of the best for raw lands such as ours. None of these did very well for us this season except the buckwheat, but from experience in the college orchard we expect the soy beans to be one of our "stand-bys" when we get our land in better shape, and we shall give the others further trial. We shall try next year, also, the common "pea bean" as a cover crop. We used it the past season to grow as a crop between the rows, and it made a splendid growth, and would have supplied a large amount of humus and nitrogen had we plowed the crop under. Of course it was sown early, in drills, and cultivated for some time before the orchard was "laid by," and I believe that many cover crops should be handled in this way to get the best results.

Still another vexed question which we had to decide, and which we perhaps decided differently from what many of my hearers would, was the question of the distance apart for the trees. We set them, as I suggested in speaking of our measuring boards, at 16½ feet apart each way. This is close planting, but that is what we wanted. It is not what we should advise for a great many men, perhaps the majority, because with most men the trees will not be cut out when they begin to crowd each other, nor will they be pruned

in such a way as to prevent crowding as long as possible. Both of these points we intend to look out for. We have used what is called the "filler system;" that is, our permanent trees are set 33 feet apart, but are interplanted both ways so as to bring the trees down to 16½ feet apart. For these fillers we are using such early bearing varieties as Wealthy, McIntosh and Duchess of Oldenburg, and for our permanent trees such sorts as Baldwin, Hubbardston, Greening and Gravenstein. We intend to practise repressive pruning, to head the trees in every year, so that they shall not begin to crowd for as long a period as possible. It ought to be possible to delay this crowding until they are fifteen years old, at the very least. But when they *do* begin to crowd, we are going to cut out the fillers and leave the entire land for the permanent trees. And right here is where the difficulty usually comes in, — most men will not cut out their fillers in time; I hope and believe that *we will.* It ought not to be any more difficult than pruning. When we prune, we cut away part of the tree for the good of the rest of the tree, and when we remove fillers we cut out some of the trees entirely for the good of those that remain. We may have to tell the foreman to cut out the fillers, and then go away ourselves and stay away till the job is done; but one way or another I expect to see those fillers come out before they have damaged the permanent trees.

The whole question of fillers narrows down to this: if a man can use fillers and bring them into bearing early enough so that they will be more profitable than growing an annual crop between the trees, and if he will then cut out the fillers, as suggested, it is a profitable scheme; but if he fails in either of these particulars, then the plan is a failure. Some people object to the filler scheme because, they say, the tree has to be cut out just in its prime. But this has absolutely nothing to do with the question farther than being responsible for most of the failures of the scheme. If the trees have been the most profitable thing you could have on the land while there, they have done their whole duty, and have vindicated your judgment in setting them out; and the fact that if they were somewhere else they might continue to be

profitable, while an interesting fact, has nothing more to do with the question at issue than the price of gas.

The last point which I wish to discuss, and one which is also largely a personal question, though there are some general principles involved, is the matter of what crops to grow in the orchard for the profit to be gotten out of the crop, and not, as with cover crops, solely to benefit the orchard; for, while the bearing orchard, of course, uses all the land and pays a profit on it, or *ought* to, the young orchard is for several years a source of out-go, and the land ought to be planted to some crop which will yield a profit, and at the same time either directly benefit the orchard, or at least not injure it.

A crop to be satisfactory in an orchard must first of all be a cultivated crop. I do not believe in either a hay crop or a grain crop for an orchard, whether young or old. And if the crop is to be cultivated, the more thorough cultivation it requires and the more nearly its season for cultivating corresponds to that of the orchard, the better. I am sure that a cultivated crop is usually far better for the orchard than if no crop is grown, for unfortunately the average man will cultivate his annual crops when he might neglect his orchard.

Secondly, a crop to be entirely satisfactory ought not to disturb the soil late in the season, as, for example, in digging a crop of late potatoes. If the crop grows late in the season, which is in itself no objection, but rather the reverse, it ought to be something like cabbage or squash, which does not disturb the soil when gathered. Of course this objection can be overcome by planting the crop far enough from the trees; but this solution has its own weak points, as we lose the use of a lot of land which might just as well be giving us a profit.

Furthermore, the crop must also be something which the owner of the orchard can either use on the farm (as a crop of turnips or mangels for stock feed), or else must be a profitable crop to sell.

The crops which we selected, having regard as far as possible to the above general principles, were beans, cab-

bage, squash and parsnips. They are all of them good crops, I think, and have in general proved satisfactory, and we shall use all of them another season.

In closing, I wish simply to say that, while I do not believe there are fortunes to be made in fruit growing, I *do* believe that there is money in it; for if a man will grow good fruit (and experience has abundantly demonstrated that we can do that here in Massachusetts), and if he will pack it honestly (and almost any man can pack good fruit that way), there is no more doubt in my mind about its being a profitable business than there is that John D. Rockefeller has found the oil business remunerative. And at the same time that a man is making money, he is also living one of the pleasantest, most wholesome lives to be found among farmers, and that is equivalent to saying among *men*.

Question. Is it a good thing to have a cover crop, which is a nitrogenous crop, on top of the soil?

Professor Sears. My contention is, that so long as your crop doesn't decay, you don't lose anything. I think that any crop, irrespective of whether it lives over winter or not, should be left on the surface until spring.

Question. Wouldn't a crop of manure be better?

Professor Sears. It isn't possible for us to use manure. There isn't any better general fertilizer than good barn manure, when you can have just what you want.

Question. What do you expect to do with your cover crop, — plow it in?

Professor Sears. Plow it in the following spring.

Question. What do you call the fillers, — every other one?

Professor Sears. In our plan we have three fillers to every permanent tree. The fillers are early bearing varieties which are grown only temporarily in the orchard and cut out when they crowd.

Question. I thought you set them out 16½ feet apart?

Professor Sears. Thirty-three feet apart.

Question. What do you think of the Baldwin trees as fillers?

Professor Sears. I believe they are all right. I think

any one who has looked into the matter will be surprised to know how long you can hold these trees as fillers, if you practise the right way of pruning. In pruning high trees, the upper branches are cut down every year to keep them from getting higher.

Question. Don't you have any trouble with the lower branches crowding?

Professor Sears. Cut the lower branches any way you desire. You don't want to cut branches that are going to spread into the middle. You would be surprised to know how often you can prune them satisfactorily.

Evening Session.

The evening session was called to order at 8 o'clock by Secretary Ellsworth, who introduced Mr. H. G. Worth of Nantucket as presiding officer.

Without extended remarks, the Chair introduced the speaker of the evening, Prof. Jas. B. Paige of Amherst, who delivered a lecture on "Lessons from a decade's experience in poultry keeping."

LESSONS FROM A DECADE'S EXPERIENCE IN POULTRY KEEPING.

BY DR. JAS. B. PAIGE, AMHERST, MASS.

Few people fully realize the importance of poultry culture as a factor of our American agricultural system. The ordinary barnyard fowl is too often regarded as a necessary nuisance on the general New England farm, rather than a source of large income and profit, as well as of maintenance for the farmer and his family.

I well remember the little flock of hens kept on the farm of my boyhood days. In summer they were expected to care for themselves, in winter provided with a roosting place in the northwest corner of the barn cellar, over the hog pen, fed a meager allowance of shelled corn each day, they were expected to provide sufficient eggs for the family. They were objects of contempt, despised and disliked by every member of the family, to be ruthlessly driven from the barn if they dared to venture therein in pursuit of a toothsome cricket or grasshopper at haying time, or to be stoned by all and chased by the dog if perchance they happened to trespass on the garden; and killed for the table, if company came unexpectedly, when other meat was not in the house. Poorly housed, underfed, despised and disliked by all, they were expected, nevertheless, to contribute their portion to the income from the farm.

Such, in brief, are my early recollections of the poultry kept upon my father's farm. From a more intimate and friendly association with fowls in recent years I have come to regard them in an entirely different light, and to consider them one of the most profitable of domestic animals that it is possible for the farmer of the present day to keep. Kept

in small numbers on the average New England farm, they require but a small expenditure for their maintenance and care. Much of their living in summer time can be obtained from the fields over which they roam. During winter, provided with suitable housing to protect them from cold and dampness, they are able to utilize as food much that would be of little use to other kinds of farm animals, and return in product a larger income for their care and food than other farm stock usually does.

The magnitude of the poultry industry as a national enterprise is astounding. At the risk of being tedious, I believe it will pay us to briefly consider some of the figures. It is to be regretted that we have no later statistics for the whole country than those contained in the twelfth census. These have been collated by George F. Thompson, and published in the Year Book of the United States Department of Agriculture. In the consideration of these figures it is to be remembered that they apply to the poultry kept upon farms, and in no way relate to that part of the industry represented by the interests of suburban poultry keepers, which constitutes no inconsiderable part of the total income derived from this branch of our agriculture.

In 1900 there were in the United States 5,739,657 farms on which poultry were kept. The total poultry population on these farms, including turkeys, ducks and geese, numbered no less than 250,681,593 individuals, thus allowing an average of 42 birds to each farm. The value of these birds amounted to $85,794,996. The value of their product in poultry was $136,891,877; in eggs, $144,286,370; plus the value of the fowls themselves, $85,794,996; making a grand total of $366,973,243.

The leading State in the industry for the year covered by the census was Illinois, with a poultry and egg product valued at $20,250,000; Iowa came second, $19,508,526; Missouri third, $17,840,623; Pennsylvania fourth, $16,231,968; Indiana fifth, $15,614,937.

Our own Massachusetts, intermediate in the list, although not to be considered an agricultural State when compared with some of those of the west, nevertheless makes a credit-

able showing, with a poultry product valued at $1,407,681 and an egg product at $2,571,341, making a total of $3,979,-022. To this amount should be added the value of the fowls, which are a permanent part of our live stock population.

According to the figures compiled by the Secretary of the Commonwealth, published in Public Document, No. 19, entitled "Aggregates of Polls, Property, Taxes, etc., for 1907," there were assessed in Massachusetts, in 1907, 911,-557 fowls, with an assessed valuation of $428,182. In comparison with the returns for 1905, this gives an increase of 192,249 birds, with an assessed value of $95,275. When we add the assessed value of the poultry returned by the assessors on May 1, 1907, to the income from poultry and eggs, it gives a grand total of $4,407,204.

Large as these figures are, they still fail to do justice to the poultry industry of the State. It is the custom, if I am not mistaken, for assessors not to include in their returns of taxable property fowls the number of which does not exceed 30. If this is the general practice, it is at once apparent that we have in this State a considerable poultry population of which no return is made to the Secretary of the Commonwealth, and does not consequently appear in the tabulated statement made up in his office from the returns of the assessors. What the number so kept amounts to it is even difficult to estimate. It is certainly sufficient to swell the total to a considerable extent, as we all know that many small flocks of birds numbering less than 30 are kept by our suburban residents. In fact, many of the best flocks of purebreds are kept on village lots rather than on poultry farms.

Even though we do not take into account these small suburban flocks, but take the figures as they are, $4,407,204 representing the value of our poultry industry annually, it is conclusive that it constitutes a factor of importance of our State agricultural system. It is apparent that we have by no means reached the limit of possibilities in this business.

While definite figures are not at hand to show what the increase in this industry as a national enterprise has been in the last decade, it is certainly safe to conclude that it has

been considerable. Evidence justifying this conclusion is furnished by the increased demand for poultry products, the increased sales of the products of manufacturers of poultry appliances, such as incubators and brooders, and the multiplication of poultry publications. As further evidence of this increase, I quote from the report of Secretary Wilson of 1905, in which he says: "The farmer's hen is becoming a worthy companion to his cow. The annual production of eggs is now a score of billions, and, after supplying the needs of factories, tanneries, bakeries and other trades, they are becoming a substitute for high-priced meats, besides entering more generally into the every-day food of the people. Poultry products have now climbed to a place of more than half a billion dollars; and so the farmer's hen competes with wheat for precedence." In the Year Book for 1907 Secretary Wilson says: "The poultry products are worth more than wheat, and perhaps as much as the hay."

Another thing, very suggestive of the increased interest that is being taken in this branch of our agriculture throughout the entire country, is the greater number of publications relative to it that are appearing, as compared with the number ten years ago. This applies not only to the poultry journals, but more especially to government and experiment station bulletins.

From January 1 to October 1 of the present year there have come to my address no less than 16 publications, comprising 604 pages of printed matter and illustrations. These have come from 11 different States, with Maine on the east and Oregon on the west, and have discussed every phase of the poultry problem, from setting hens to the construction of "Jumbo" incubators.

The conditions in Massachusetts are not less favorable for poultry culture than are found to exist throughout the Union. As has already been mentioned, there has been an increase in the number of fowls reported by the assessors in the last three years of 195,249, with an assessed value of $95,275. This is but one of many things that points to additional interest in poultry keeping in this State.

The suburban residents are engaging more and more in

the industry each year; new poultry plants of larger capacity are being built; the demand for poultry and eggs is constantly increasing. In spite of the great development along the various lines of the industry, we are still unable to supply the demands of local trade, and each year finds us importing from outside sources from four to five times the product of our own poultry plants. Certainly the limit of profitable production has not been reached. There are in many localities large areas of comparatively unproductive land that are ideal for poultry raising. Lands that now yield meager returns to their owners could easily be made to return a handsome profit through poultry culture. Many of these tracts are favorably situated to allow of easy marketing of products at the least expense.

The New England poultry keeper cannot compete with the western producer, on account of low freight rates and less cost of feed in the west; but this should not deter him from engaging in the business when his land is adapted to less profitable use. In a measure there is no competition between the two, for the demand for an eastern product of superior quality has created a market for itself that is scarcely affected by the western product.

The present price of the different grades of eggs in the Boston market, as quoted in a recent number of our most reliable poultry publication, "Farm-Poultry," bears out this statement: —

	Cents.
Fancy hennery,	40–41
Maine, Vermont and New Hampshire extras,	35
Maine, Vermont and New Hampshire common, good,	22–24
Indiana, Illinois and Northern Ohio, selected,	24–26
Other choice western,	23–25
Western common to good,	20–22
Western dirties,	14–17

A comparison of the prices of poultry shows a similar difference in favor of the eastern product.

In our local market strictly fresh eggs are selling at 50 and 55 cents per dozen. Never before in eleven years has

the price been over 45 cents, and even at present prices the supply is not equal to the demand.

A study of the range of prices of eggs in Massachusetts, in comparison with some other States, lends support to my statement that our poultry keepers have little to fear from western competition. Mr. Thompson gives the figures for production for thirty years in decades from 1879, and the average price in 1899, in his paper already quoted from. These figures show that for these years Massachusetts stands fifth in the list of all the States and Territories in which high prices have ruled for eggs.

Average Price per Dozen.	Cents.
In Nevada,	20.8
In Montana,	20.6
In Rhode Island,	20.4
In Arizona,	20.0
In Massachusetts,	19.9

A comparison of these high, with some of the low figures magnifies these prices.

Average Price per Dozen.	Cents.
In Texas,	7.7
In Arkansas, In Indian Territory,	9.0
In Oklahoma,	9.3
In Alabama,	9.7
In Kentucky, In Mississippi,	9.8

In Illinois, Indiana, Iowa and Ohio, the States of largest egg production, the price varies from 10 to 11.1 cents; the average for all the States and Territories is 11.1 cents.

In the thirty years mentioned the production of eggs in nearly all the States has doubled, and in many of the large producing ones trebled and even quadrupled; the price has almost without exception advanced from year to year.

According to Bulletin No. 99 of the Arkansas Experiment

Station, the cost of feed to produce a dozen of eggs with four varieties of fowls is as follows: —

	Cents.
Plymouth Rock,	7.02
S. L. Wyandotte,	6.85
S. C. W. Leghorn,	6.51
Buff Orpington,	6.90
Average,	6.82

In computing the cost of feed to produce a dozen of eggs, the corn was reckoned at 50 cents per bushel, wheat at 80 cents, shorts at $1.10 per hundredweight, bran at $1, linseed meal at $2.60, blood meal at $5.50, and beef scrap at $3 per hundredweight. These figures were obtained from four small flocks of fowls, aggregating 31 birds.

A comparison of the record for the year 1907 of my own flock of 27 White Wyandottes shows that, while we can hardly expect to produce as cheaply in Massachusetts as they do at the Arkansas Experiment Station, we can nevertheless get a sufficient profit to make the undertaking, under our conditions, a paying one.

The total number of eggs produced by the 27 Wyandottes was 286⅓ dozen. The total receipts from the flock amounted to $85.45; cost of feed, $50.22; net profit from eggs, $25.23; per cent of profit, 50.

Leaving out of the account the item of labor and poultry, I find that it cost for feed alone, all of which was purchased, 18 cents to produce a dozen of eggs, with a flock in which the average egg product amounted to 127½ eggs per hen. The selling price averaged for the year 30 cents per dozen, giving a profit of 66⅔ per cent to cover items of labor, etc. It is doubtful if one can, with a flock of 500 to 1,000 birds, derive as large a per cent of profit.

The total net profit derived from poultry and eggs from the flock of 27 birds amounted to $35.23. A large part of the fowls were sold for the family table, at 50 cents each. None were sold for more than $1.50 each. The cost of feed for egg production for each bird amounted to $1.86 per year.

Bulletin No. 122 of the Massachusetts Experiment Station, giving the results of a series of experiments covering a period of thirteen years, states that the average cost of eggs produced on a narrow nutritive ration has been 12.6 cents per dozen; on a wide nutritive ration, 9.96 cents. The annual feed cost per hen on the narrow ration amounted to $1.16; on the wide ration, 98 cents.

A comparison of the experiment station figures with my own shows a wide variation in the cost of feeding fowls and producing eggs in the same locality. This is undoubtedly to be accounted for in part by the lower price at which feed has been bought in large quantities by the station, and by the much lower prices that prevailed for grain previous to 1907.

Taking even the higher figures that apply to my own flock, they certainly show that poultry keeping in Massachusetts may be expected to return as large an income for the expenditure and labor and a net profit equal to that to be derived from any of the lines of farm operations carried out on the general New England farm.

Whether considered as a national or State enterprise for the past decade, we are bound to conclude that the limit of profitable poultry and egg production has not been reached, and that it offers at the present time, all things considered, as fruitful a field for labor and capital as any of the usual lines of agriculture that are open to the average farmer.

From a decade's experience in poultry keeping in a small way on a village lot, engaging at different times to a limited extent in various branches of the business, such as use of different kinds of incubators and brooders in comparison with the natural methods of hatching and rearing, feeding, mating, buying, selling, advertising, fitting, showing, caponizing and studying diseases, etc., I am convinced that there are three principal factors that should enter into a further discussion of this poultry-keeping proposition: they are, the man, the fowl, and the methods. A fourth factor would be capital, if we were to discuss the subject from the point of view of its being engaged in as a sole occupation. I shall not enter into a discussion of this phase of the subject.

The first of these factors, it seems to me, is of the greatest importance. The success or failure of any enterprise must to a great extent depend upon the character of the person engaging in it. The abandoned and dilapidated poultry houses too commonly seen in many sections of our State testify to the fact that far too often there are those who take up poultry keeping as an occupation without the qualities which are necessary to success in it. They are evidently in many respects better fitted to follow the directions their houses advertise — to use only the genuine, that bears the name of "Fletcher" — than to engage in the occupation for which the houses were built. A poultryman who compels his birds to take in a blazing sign of "Wilson's, that's all!" for three hundred and sixty-five days in a year, ought not to complain if they occasionally take a "day off."

To succeed in poultry keeping, a person must be adapted to the business, first of all, by having a natural liking for the fowls themselves. The farmer who cannot tolerate the sight of a hen, and improves every opportunity to shy a stone at her or to dog her from the barn or garden, can hardly expect to receive a bountiful supply of eggs for his favors.

Fowls, to do their best, must be well cared for and kindly treated, the same as other domestic animals. The careful poultryman should no more think of frightening his fowls than the successful dairyman would of exercising his milch cows with the milking stool. Egg production is a function of the hen that is as much under the control of the nervous system as is milk secretion in the cow or speed in the horse. To get the best results in either case the controlling mechanism must be kept in a perfect state of equilibrium. We observe the effects of disturbing influences in upsetting egg production in show birds. The pullet, in the pink of condition, that has just commenced laying, placed on exhibition in the show room for a few days, stops laying for a month or more, and frequently, when shown in the fall shows, molts. The same effects frequently follow changing a bird from one pen to another. Birds accustomed to a certain individual are often frightened by the presence of a stranger

or by an unusual garment on a regular attendant. These disturbing influences interfere with and upset egg production. The rule should be, keep the fowls in a quiet and contented condition.

The lazy man has no place in the poultry fraternity. "Everlastingly at it" is the key to success in the hen business. There is always something doing about a poultry plant that cannot be postponed without the possibility of harm resulting. The birds are always on hand, even if the man is behind time. To anticipate their wants is more profitable than to let them make them known to you.

The incubator, brooder, sitting hen and the hen with her chicks, feed supply, feeding, watering, clean dropping boards and litter, fresh sand, clean houses and yards, and above all vermin, are some of the things that demand the time of the poultry keeper. Each item of the list is of so much importance that a neglect of one may mean failure in the end.

The man who has neither time nor disposition to attend to the wants of his birds at the proper time had better give up the poultry business and go to keeping bees, which are capable of looking out for themselves. A man is inconsistent when he sets an example of indolence, and expects his hens to be industrious. The chickens will not pick up worms faster than they are brought to the surface by the one with the spade.

Our dilapidated and deserted poultry houses, which far too often extol the imaginary virtues of medical nostrums, advertise in larger letters the indolence of their owners, and the miserable failure of an attempt at poultry keeping. The thoughtful and industrious poultryman should be quick to adopt an efficient labor-saving device to reduce the cost of the care of the flock, but never under any condition allow a thing to remain undone that is essential to the well-being of his birds.

As I view in retrospect my decade's experience, I am taught that persistency is a necessary quality of the successful poultryman.

The multifarious things to be done about a poultry plant,

that are a source of pleasure and recreation to the novice, soon become arduous toil, as the newness of the undertaking wears away. Success in the end, as at the beginning, depends upon these things being done; neglect spells failure.

The showman who takes delight in preparing his birds for the show room, when a novice, after a time secures the services of the good wife to assist in washing and drying the birds previous to placing them on exhibition, and after a longer time neglects the preparation altogether.

As I look back over ten years' experience in local shows and associations, and recall to mind those who contributed to the exhibits, I find that many of the most prominent exhibitors of ten years ago are now out of business, and that the amateur of a decade ago is to-day the winner. The reason is only in part of course due to lack of that quality of persistence, which is as essential to success in any undertaking as in the poultry business.

Neglect leads to failure, through gradual deterioration and diminution of the flock. The development of unsanitary conditions about the buildings and yards opens the way for the development of diseases and disorders that are fraught with disaster. Filth accumulates, vermin multiplies, and disease devastates the flock. These results are to be averted by constant and persistent efforts on the part of the poultryman.

In addition to having the qualities of industriousness and persistence, a man must be observing, careful and systematic, to succeed with poultry.

One in whom the power of observation is not prominent allows many things to pass unnoticed that should direct his attention to faults or conditions that ought at once to be remedied, and which if taken in time could be easily corrected, but allowed to develop prove a menace to the business and finally lead to serious results.

An exhibitor fails to secure the coveted first prize on his pen because he overlooked the little stub beneath the scale on the shank of an otherwise faultless specimen. The unobserved first case of roup brought into the flock starts a disease that is the bane of the poultryman, and is with the

greatest difficulty eradicated. The careless, unobserving feeder gluts the chicks in the brooder, bringing sickness and death as a result. The person who lacks in being systematic forgets to note the temperature in the incubator or brooder, and finds later to his sorrow that his eggs have been cooked or frozen, or that the chicks have passed into the great beyond as roasters or fallen into a stupor of hibernation, never to awaken.

Essential as all of these characteristics are to the ordinary poultryman, they are more necessary to the breeder of pure-bred stock. An immediate recognition of a defect of breeding may enable one to easily overcome it; but once firmly fixed as a type of the strain, its eradication may require the work of years. The careful breeder notes the desirable qualities as well as the defects of his matings, and is quick to observe the results in the progeny. A little thing like the use of a Wyandotte male with a slight bifurcation of the point of the comb, in a breeding pen, in every other respect a desirable specimen, may result in the introduction of a defect that in the future will cause many a bird to be disposed of to the marketman which otherwise might have been sold from the show room at a fancy price. Close observation, care and system point the way to success in poultry culture.

Another qualification of the successful poultry keeper is business ability.

My observations during the past ten years convince me that many men fail to succeed in the business, owing to a lack of sufficient business ability to enable them to buy and sell to the best advantage. They may have the other qualities necessary, but not being proficient in this respect, they fail. Advantageous buying means lessened cost of production. Good selling means an increased income that may make the difference between a loss and a profit.

A first-class product, marketed in an attractive form, will command a top price; consequently, good selling as frequently depends upon the honesty of the seller as upon his ability to drive a sharp bargain. With no other farm product is this more true than of eggs and poultry. Strictly

fresh eggs, with the reputation of an honest poultryman behind them, are never a drug on the market in Massachusetts.

I know of a young man in this State who five years ago started a 1,500-hen poultry plant for the production of eggs. He had formerly been engaged as head salesman in a city store, so had a general knowledge of business methods, but was without experience in poultry culture or farm practice. The eggs from the plant are wholesaled to the markets in a city of the Connecticut valley, and without exception bring from 2 to 5 cents more per dozen than other strictly fresh local eggs, because all are sorted, cleaned, and marketed in an attractive package. Every egg sold from the place is an advertisement of it, as each bears the name of the owner in indelible ink, which is a guarantee of quality and freshness.

The man who pays a fancy price for a setting of eggs from a winning pen of Boston or New York White Wyandottes, and gets half Brown Leghorn chicks in the hatch, has no words of praise for the party who sold the eggs.

Another requisite for success, where a specialty is made of producing pure-bred stock, is the liberal and judicious use of printer's ink and the show rooms for advertising.

One may sit in his hen house for days, admiring the beauties of his birds, without the members of the fraternity knowing of the existence of the flock. Contact of breeders in the shows stimulates competition, creates enthusiasm, leads to an exchange of ideas and the sale of stock and eggs. The winning of a blue ribbon in one of the large shows gives the exhibitor a temporary business acquaintance with every breeder of the same variety in the country. To maintain this acquaintance, it is necessary that the name of the successful competitor be kept constantly before the poultry people.

There comes to my mind the case of a small breeder who very unexpectedly captured first prize in one of the large shows, on a pen of birds which at the time were coming into great popularity. From the start thus obtained, by judicious advertising and exhibitions he built up a large and lucrative trade and an enviable reputation among breeders that con-

tinued for several years; but to-day I cannot even recall his name, it having disappeared from the poultry papers some two or three years ago.

With reliable stock for sale in sufficient quantities to warrant the expenditure, the poultryman fails of his goal who does not advertise. When an expenditure of $5 in advertising sells $300 worth of stock, as it did in one instance, to my knowledge, I am satisfied that the breeder who has first-quality stock to dispose of can make no better investment in the interests of his business than to keep his name before the public through the medium of the press. To accomplish the desired results, a careful selection of the medium must be made, and an attractive and catchy form of advertising adopted.

Having a person possessing the necessary qualities to warrant his engaging in poultry keeping, the next important matter for consideration is, What variety of fowls shall be selected? The answer to the question depends upon the object in view. There is with chickens, as with cattle and horses, no satisfactory dual-purpose breed. The American breeds, of which the Wyandottes, "Rocks" and Rhode Island Reds are good examples, are perhaps more general-purpose among the fowls than are any particular breeds among horses and cattle. For special purposes careful selection of the breed for that particular purpose is necessary. The specialist in capons, broilers or roasters depends upon the strictly meat types, either pure or as crosses. The production of eggs alone calls for the use of the Mediterranean, non-sitting varieties. The show room and fancy trade profit alike from all varieties of pure breeds.

It is interesting to note what careful observation has taught during the last decade relative to the comparative merits of some of the so-called laying breeds with the more general-purpose types of American origin, as egg producers. Bulletin No. 99 of the Arkansas Experiment Station, already quoted from, gives the average annual product of four small pens, of as many varieties, as follows: —

Annual Average, Eggs per Hen.

Plymouth Rocks,	141.10
S. L. Wyandotte,	101.16
S. C. W. Leghorns,	109.45
Buff Orpingtons,	108.12

My own limited experience with White Wyandottes in comparison with S. C. Black Minorcas, under exactly the same conditions, gave similar results, slightly in favor of the Minorcas, the Wyandottes averaging 144 eggs per year, the Minorcas 150.

Taking into consideration the value of the former as a table fowl over that of the latter, and having quarters for only one breed, I have discarded the Minorcas and retained the Wyandottes. For egg production alone I am inclined to think the Minorcas a valuable breed. The eggs, although chalky white, are large, and satisfactory for a local trade. The birds are hardy, but, on account of their large combs, must be provided with warm winter quarters to protect them from frost.

The breed for the fancier must be determined largely by the breeder's personal tastes and the demand for the particular breed.

Taking everything into consideration, the most profitable breed I have ever kept was the Red Pyle Game Bantams. A familiar remark of those not acquainted with the exhibition Games is, "What is that chicken good for? I wouldn't give 5 cents for it." As fowl for the table, or as layers, the remark is a fitting one; but for the show room and sale they are fully as profitable as the larger breeds. From a trio of the variety I let out to a farmer's boy one season, for which I paid him $5 for their keep and care and the five or six chicks that he raised, I received more income, from show winnings and sales, than from five times the number of White Wyandottes that were raised on the home place, and were also exhibited and sold at pure-bred prices. The same is practically true of any of the odd breeds of first quality. In the keeping of the less popular and productive varieties one has always to bear in mind that the de-

mand is limited. However, for stock capable of winning in the sharpest competition there is always a good demand at high prices.

The meat breeds for the poultry producer, the Mediterranean or American breeds for eggs, any pure breeds of first quality for the fancier, — but what for the farmer? My first answer is, pure-breds of the variety fitted for the purpose and the conditions under which they are kept. For the florist or the market gardener, or one living in a thickly settled community, where fowls at large would lead to neighborhood infelicities, I should advise against keeping the Leghorn type, which are with the greatest difficulty kept inside of enclosed yards, unless covered. For the general farmer and the specialist, as the gardener or the florist whose demand is limited to an egg supply and an occasional fowl for his table, the pure-bred is not essential. In fact, it is believed by many practical poultrymen who produce eggs alone that a cross-bred bird has a greater constitutional vigor and egg-producing capacity than any of the pure breeds. This is unquestionably true in many instances, but not in every case. In my opinion, within reasonable limits the egg-producing quality is as much or more a characteristic of a particular strain as it is of the breed.

The work of the late Professor Gowell of the Maine Experiment State, as reviewed in Bulletin No. 157, relative to breeding to increase egg production, is of the greatest interest to every one engaged in poultry culture.

Briefly, his experiment consisted in selecting for breeding purposes the best layers of a flock, as determined by the use of trap nests, and mating them with males from hens laying over 200 eggs per year, expecting by this method to obtain after a few years a strain of heavy layers capable of producing a larger average number of eggs per year than the original stock. After nine years' work along this line, it was found "that the general trend of average annual egg production has been slightly downward throughout the course of the experiment." Since the death of Professor Gowell the station has planned an experiment along similar lines carried on by him, but taking into consideration in the

matings more of the influences liable to be perpetuated as hereditary characteristics.

An experience of my own with two different birds goes to show that there are many intricate problems to be solved in the development of a 200-egg strain of fowls. In my first flock of Wyandottes there was one particular hen of fine color and conformation. She was of medium size, hardly up to standard weight, low down, very short backed and blocky, with a perfectly shaped Wyandotte comb, a heavily cushioned saddle and beautiful fluff. While resembling the Wyandotte type in a general way, she differed sufficiently in many details to make her a conspicuous member of the flock. On several occasions she was shown in competition at the show of the Greenfield Score Club, and was a winner of the blue ribbon, for which reason she received the name of "Greenfield." My records show that she disappeared from the flock in 1902. During her stay in the flock she was mated with several different males, and subsequent to 1902 there has been introduced at different times new blood from several sources. Last fall (1907), to my great surprise, I found a duplicate of "Greenfield" among my pullets, and as she has developed with age her resemblance to the original "Greenfield" has become more marked. I have of course no way of knowing that the present "Greenfield" is the progeny of the original, but the resemblance is sufficiently striking to be at least suggestive that she is. Some four or five years ago I purchased a Red Pyle Game Bantam pullet of the late A. A. Parker of Dunellen, N. J., one of the best breeders of this variety in the country. She was an individual of fine conformation, style and station, but defective in that she had "willow" legs, and her feathers had a tendency to crinkle or frizzle. She died in 1906, and up to the present year there has been no individual in the flock that resembled her in the least. Among this season's chicks there is an early hatched pullet with feathers like the Parker hen, but her legs are yellow. Although positive proof is lacking that the present bird with crinkled feathers is the progeny of the former bird with that peculiarity, the coincidence is certainly suggestive of some

of the factors that must be taken into account when an attempt is made to create new or improve functional characteristics in a breed of fowls.

When we compare the physical characteristics of the Wyandottes or Rhode Island Reds of ten years ago with those of to-day, we are impressed with the progress that has been made in the improvements all along this line, as indicated by a more uniform conformation and color, a larger percentage of well-formed combs, and other equally desirable points of conformation that are typical of these breeds. It will be interesting to compare, a decade hence, the results of the numerous experiments that our experiment stations are carrying out to improve the laying qualities of fowls with the progress of the last ten years in the improvements of conformation characteristics, to see if the functional characters are as easily modified as are the physical.

Regardless of breed, color or conformation, every poultry keeper ought to procure a strain of birds possessing a strong constitutional vigor. In years past we have in medicine been accustomed to attribute all defects of life, the cause of which has been obscure, to the effects of heredity. Many of the false ideas that have prevailed have been dispelled by the brilliant achievements of modern bacteriology, so that to-day those diseases formerly thought to be transmitted direct from parent to offspring are known to be the result of direct infection, due in a large measure to environment. The present generation of poultrymen is inclined to take refuge behind that indefinite thing designated "constitutional vigor," when an apparent cause for some undesirable condition that prevails is not readily discovered. Constitutional vigor to me means that condition of the system derived from ancestral sources or environment that is favorable to a strong and rapid development of the body, a full functional activity of every organ, and a maximum degree of resistance to disease. In practice it stands for early development of birds, the production of a normal number of eggs with germs of full vitality, strong chicks that live and thrive even in the face of obstacles, and fowls that resist the attack of those diseases that far too often devastate our flocks.

Under the heading of methods I shall discuss only two lessons that have been taught me by a decade's experience in poultry keeping; they refer to the methods of housing and the influence of free range.

During the past ten years our ideas regarding the housing of poultry have turned completely "up side down." We have passed through a series of evolutions, from the tightly built close house to the other extreme of those of the present time that are largely open, with all grades of construction between the two extremes. One of the earlier plans called for a maximum amount of glass; a later, for a minimum amount. We have tried the scratching-shed plan, only to become convinced that it was not economical or efficient. We have tried both single and double sloped roofs, high in front and low in the rear, and the reverse, with and without walks, with solid partitions and with partitions of netting, and the end is not yet.

It is not my purpose to discuss in detail the advantages and disadvantages of the great variety of poultry houses that one sees, or that are described at length in our numerous poultry publications, but to speak of what I believe I have learned is the fundamental principle in this matter.

Two important essentials for the preservation of the health of poultry in this climate are dry air and sunlight; and the construction of our poultry houses so as to provide these in the largest amounts should be our chief aim. Nature provides fowls with a sufficient covering to protect the surface of the body from the effects of extreme cold by preventing excessive radiation of heat, generated internally by the oxidation of food. Dry air retards radiation of surface heat; moist air favors its escape from the body. It is an easy matter to convince one's self of the correctness of this statement. Its application to the housing of poultry simply means that when the feathers, naturally non-conductors, are enveloped in moist air there is rapid radiation of heat taking place. This has a tendency to lower the surface temperature and produce a chill. On the other hand, dry air circulating through the fluffy feathers carries away but little surface heat. Draughts of cold air have the same effect as moist

air, to a less extent. The inference is to build poultry houses with tight walls on the exposed sides, and to provide for the exclusion and escape of an excess of moisture. Poultry houses should be built on a dry, porous, well-drained soil; or, when this is impracticable, the soil should be artificially drained. If there is the least tendency for moisture to come in through the soil, a cement floor laid over six inches of soft coal cinders, or a floor of wood put in well elevated above the soil will remedy the trouble. Cold, dry air under a floor of wood is less objectionable than an air saturated with moisture. Dry air and dry floors tend to suppress bacterial and parasitic diseases.

Sunlight is beneficial, in that it acts as a germicide, drives out moisture and exerts a favorable influence on the fowls. Damp, dark and cold quarters are as injurious to the health of poultry as of persons.

In stating what I believe experience has taught me, namely, that it is impossible to maintain the health standards of fowls raised for successive years in confinement, I am aware that I am opening the way for an attack by some very successful poultrymen with extended experience to support their arguments in opposition to the ground I have taken. I am nevertheless convinced that my belief is not without some foundation. Chicks in restricted quarters are constantly surrounded with those things which have a tendency to inhibit and suppress growth. In confinement they are more subject to infection with disease-producing bacteria and animal parasites, that are the cause of the majority of the fowl diseases. Chicks in close confinement fail to obtain the variety of food and the exercise that those raised on free range get, both of which are favorable to strong and early development.

Last spring I supplied two friends with two settings of eggs from my pen of Wyandottes. These were hatched under hens, with average results. At the time these were set I already had eggs nearly ready to hatch. My own chicks are raised under fairly favorable conditions as regards free range, being kept in an enclosed grass yard about 80 feet square, from which all hens except those brooding the chicks

are excluded. The chicks hatched from the eggs supplied my friends were from the time they hatched allowed to range at will, never being confined except at night, to protect them from marauding cats and skunks. Both lots hatched two weeks later than my own, grew more rapidly throughout the season, and at all times were more robust and thrifty. The eggs for the three lots of chicks were from the same pen of fowls. Admitting that other things, care, etc., were equal, except that one lot was raised on restricted range, the other two on free range, it is interesting to note that the first egg from my own lot came on November 27, whereas some of the pullets in the other two lots had been laying for three or four weeks. Free range also gives the chicks an opportunity to secure a considerable portion of their food, and thus reduces the cost of production.

Great as have been the accomplishments of this lowly denizen of the farm in the past, we can well afford to encourage and promote its interests in the future by the adoption and practice of improved methods of care and treatment.

Question. Can you raise as many chicks with a brooder as under hens?

Professor Paige. Ordinarily not, — not with a common, out-of-door brooder, at any rate. With the modern brooder-house, that is heated artificially, I think quite likely as many can be raised under artificial conditions as under natural conditions. My practice has been for some years to hatch the chicks in an incubator, and give them to brooding hens if I happen to have them, rather than to go to the trouble and expense of running the brooder. My experience with out-of-door brooders has not been very successful.

Question. Is there any way of controlling the molting of hens, — year-old hens, we will say?

Professor Paige. It has been advocated that during the summer, when the price of eggs is low, one should restrict the food given his fowls, and then, at a little later date, feed them liberally, with the idea of forcing them to molt early in the fall, so as to get them to laying at that time, rather than to allow them to molt naturally later, and not start to

lay until the first of February. With a small brood of birds no doubt it is possible to have that result, if carefully planned. With a large brood of birds that have free range, taking care of themselves to a great extent, getting more or less food that the poultryman does not supply, I hardly think it is practicable or possible to regulate the molting.

QUESTION. Do you feed mashes, or adopt the dry system?

Professor PAIGE. For several years I used mashes in combination with dry food, mixed up the old-fashioned chicken dough for the morning food, composed of corn, some bran, a little middlings, and either meat meal or beef scrap, and in winter time fine-cut clover; and fed at noon a small quantity of corn or wheat, and at night a liberal allowance of dry grain. I found that method to be somewhat troublesome, situated as I was, and I rather wanted to try the dry food method, so I discarded wet food entirely, and am using in its place a scratching food, the base of which is corn. It also contains wheat, oats, a little barley, some buckwheat and sunflower seed, and possibly at times a little rye; and I mix with that, as it comes from the grain dealer, about an equal quantity of cracked corn. I cannot see but what the hens produce just as many eggs, thrive just as well on the dry grain as they did on the combination of moist and dry food.

QUESTION. What is the best food for maturing chicks, up to the time the pullets begin to lay?

Professor PAIGE. I think young chicks require a variety of food, the base of which is cracked corn, some wheat, oatmeal and a little rape seed. Above all things they must have green food and animal food, in addition to the grain ration. That green food can be supplied in one of several forms. If the chicks are raised in restricted quarters, you may use cut clover, cabbage, mangels, sugarbeets, or you may actually cut green stuff in the fields and give it to them. The animal food may be supplied in meat meal mixed in the mash. I do not care for it; it has the odor of fertilizer. I prefer meat scrap that is perfectly fresh; or you can supply that animal matter in the form of green-cut bone. I think it essential that they be fed a variety of grain, vegetable

matter in the form of green food, and animal matter in the form of meat of some kind, unless they are allowed free range, and get their animal matter in the form of insects.

QUESTION. Do you give the grain feed dry, or in the form of mash, while they are growing?

Professor PAIGE. I think it makes but little difference, so far as the chicks are concerned, if they are properly fed and well cared for. It makes a greater difference, possibly, from the poultryman's point of view, than it does from the chick's point of view. Dry foods are more easily fed than wet mashes, and require no preparation.

QUESTION. What is the cause of disease among turkeys?

Professor PAIGE. *Entero hepatitis,* — in common language, inflammation of the intestines and liver; it is the disease ordinarily called black-head, and is a very serious disease among turkeys. It has practically ruined that form of poultry industry in this State, if not adjoining States. I am not prepared to say exactly what the cause of it is. Early investigation made by workers from the Bureau of Animal Industry, carried out at the experiment station in Rhode Island, gave as the cause a low form of animal life, protozoa. The most recent investigation at this station goes to show that it is another form of protozoa rather than the amœba. They do not know exactly what the life cycle of that parasite is. They do not know how it is transmitted, — possibly by common fowls. When it infects the poults, about the first thing noticed is that they begin to droop, refuse food, and in some cases the heads get black, consequently that name black-head. After a short time, either a few days or a few weeks or months, they die. When you make an autopsy, you find hardened spots on and in the liver, which under the microscope show these low forms of animal life present, and you will also find them in other parts of the body. You will also find the cæca prominently distended with gas, and if cut open you will find the mucous membrane eroded and ulcerated, and you will find inflammation in the intestines and a condition of decay. Little progress has been made towards the eradication or prevention

of this trouble, and it extends all over Massachusetts. It is going to be a very serious problem.

QUESTION. I think you have said nothing about the absolute necessity of having an abundance of fresh water with the fowls at all times, especially if they are being fed dry mashes.

Professor PAIGE. Of course fresh water is as essential as air and food.

Mr. B. W. POTTER (of Worcester). I have found it harder to have the hens on my farm taken care of than anything else. I have never had a man on the farm who liked to take care of hens; they always regard it as a thankless job, and don't like to do it. I found, when I was feeding mashes three times a day, that they would not get round at night to feed in season, it being too dark in winter time, so I changed my system. Now, in the morning we give the hens a feed of cracked corn and buckwheat, and a sort of mixture put in the straw for them to scratch. I have a box arranged so that they can reach up and eat without getting the feed on the floor, and in it I put ground grain, corn, oats, anything like that, so they can get it any time they want it through the day. Then we leave them alone, and don't go near them much except to gather the eggs, when there are any to gather. I have been doing this for about a year, and I do not see but what we get just as many eggs and have the hens do just as well as when we were fussing with them two or three times a day.

Professor PAIGE. It seems to me Mr. Potter has a very good system of caring for his hens. One of the essentials in feeding I believe to be this, — that the hens should be thoroughly filled with food when they go to the roost at night, particularly so in cold weather. That has been the objection raised to the feeding of mashes at night, rather than corn or ground grain. If Mr. Potter has a hopper full of food before his birds, so they can get their crops full before retiring to the roosts for the night, I see no objections to the system he has adopted.

Secretary ELLSWORTH. One thing may seem of minor

importance, and that is the color of the fowls. I have been told by the large breeders that white feathers sell for about three times as much as colored feathers. I always like to see white fowls on the farm as I ride around the different parts of the State, and I like to see large flocks of one color or kind.

Professor PAIGE. I think marketmen prefer the white fowl, — that the demand is for white-feathered birds. I quite agree with Mr. Ellsworth that white birds on a green lawn are more harmonious than birds of darker shades, like red, black or buff. I further agree with him that, if I am going to have any birds, I want them all of the same kind. For the farmer there is no question but that the dark-colored birds are preferable to the white ones, because experience goes to show that white birds are easy marks for hawks, and are invariably selected by the hawk, rather than dark ones, when the two run together.

QUESTION. Would the germs from decayed meat be carried to the egg and make it injurious to health?

Professor PAIGE. The transmission of germs from decayed meat or any infected food to the egg direct I should say would not be likely to occur. Odors, I think, are transmitted in some cases. Onions fed to birds will produce eggs that have an onion taste. Partially decayed scrap might also leave a taint upon the egg; and I understand fish scrap fed too liberally may give the eggs a fishy taste.

QUESTION. How long is it profitable to keep hens?

Professor PAIGE. For early egg production there is nothing like middle-aged pullets. It is economical, however, and I believe a paying practice, to keep birds through the second year; but I have my doubts about it being profitable to keep them through the third year. Of course with fancy stock, where you are breeding, a good individual should be kept as long as it will produce good healthy stock.

QUESTION. Why is it, in operating incubators, we find so many dead chicks in the shells?

Professor PAIGE. Nobody can answer that question. If anybody knew of a remedy, it would be supplied at once, and we would have incubators that would prevent the death of

chicks in the shell. I know exactly what the gentleman refers to. You put the fertile eggs in, and at the twentieth day the chick does not come out of the shell; perfectly formed, but just simply does not emerge from the shell. It is a greater trouble with eggs hatched in an incubator than in the natural way, under a hen.

Question. Isn't it due to a lack of moisture in the incubator, rather than under the hen, particularly where the nest is on the ground, the eggs do not get so dry?

Professor Paige. Experiments have been conducted all along that line, of increasing and decreasing the amount of moisture in the incubator, but they have not found any remedy for it. Even when moisture is kept in the incubator until the chicks are hatched, it does not seem to make so much difference. Perhaps with one particular make of incubator it may be successful, but when applied to all it does not remedy the defect.

Question. As to that disease that affects our poultry, incubator-hatched chicks, known as diarrhœa, — they are complaining that they could not get much assistance. That was a year ago. Is there any more light on the subject?

Professor Paige. A worker in the Bureau of Animal Industry at Washington has within a few months published a circular, in which he claims to have discovered the cause for that diarrhœa; and he thinks, beyond question, that it is due to a protozoa that is transmitted by way of infected food and water to the chicks after they are hatched.

Question. Except looking after the food supply, is there any way of getting rid of it?

Professor Paige. No remedy; he does not claim to have found anything.

Second Day.

The meeting was called to order at 10.30 a.m. by Secretary Ellsworth, who introduced Mr. John J. Mason of Amesbury as the presiding officer for the forenoon session.

Without preliminary remarks, the Chair introduced Mr. Charles Stewart of Johnstown, N. Y., who delivered an address on "Profitable bee keeping."

PROFITABLE BEE KEEPING.

BY MR. CHARLES STEWART, JOHNSTOWN, N. Y.

Shakespeare says: —

So work the honey bees;
Creatures, that by a rule in nature teach the art of order to a peopled kingdom.
They have a king and officers of sorts;
Where some, like magistrates, correct at home;
Others, like merchants, venture trade abroad;
Others, like soldiers, armed in their stings,
Make boot upon the summer's velvet buds;
Which pillage they, with merry march, bring home,
To the tent royal of their emperor;
Who, busied in his majesty, surveys
The singing masons building roofs of gold;
The civil citizens kneading up the honey;
The poor mechanic porters crowding in their heavy burdens at his narrow gate;
The sad-ey'd justice, with his surly hum,
Delivering o'er to executors pale the lazy yawning drone.

But the talk I propose to give you to-day will be along practical rather than poetical lines. It would be the height of inconsistency to attempt to teach you how to make a business profitable had I not been successful, and I hope that after years spent among the bees and bee keepers I may be able to offer some suggestions here that will bring dividends to you in the years to come.

To be a successful bee keeper one should be enterprising and industrious and learn to do the right thing at the right time.

Many people fail in this pursuit, not so much from a lack of knowledge as from not giving the necessary attention at

the proper time. Thousands of bees are lost every winter because the owner guessed they had enough stores. Thousands of swarms abscond from inattention on the part of the owner during the swarming season. Tons and tons of honey are lost from enforced idleness because the colonies were not provided with room at the proper time.

I once had a man visit me at my home to learn why, after years of bee keeping, he had not been successful. After a long conversation with him I said: "There is never an effect without a cause, and it seems you have never expected a crop of honey. If I were to suggest a motto for your shop it would read something like this: 'Blessed are they who expect nothing for they shall receive it.' You must have faith that you will get a crop, provide everything necessary to secure it and persistently work to that end." To-day this man is one of the large producers of honey, and has three fine bee yards, and says the most profitable day he ever spent was the one when he found out why he had failed.

Many keep bees for the pleasure they derive from a study of their habits, and, after having overcome the fear of stings, discard both veil and gloves, and by using a little smoke handle them freely, caring little for a few stings as the system becomes adapted to the poison.

Bryant has truly said: "To him who in the love of nature holds communion with her visible forms she speaks a various language." To most people the hum of the bee means but little, but to the expert it may mean joy, sorrow, anger or curiosity, and he governs himself accordingly. Nature is selfish in her ways and is slow to give up anything without exacting something in return. Honey is not secreted in the blossom from any philanthropic motive, but rather to entice the bee to come in contact with the pollen, and carry it from flower to flower and insure cross fertilization and thus reproduce its kind. Plants may be divided into two classes, — those bearing wind flowers and those bearing insect flowers. In the former may be classed corn and timothy, whose pollen is distributed by the wind, while to the latter class belong fruits and berries which are largely dependent on insects. A

very extensive series of experiments were conducted at one of our New York State experiment stations a few years ago at the request of the fruit men, who expected to prove that the good offices of the bees were not necessary to secure a full crop of fruit. But they were greatly surprised to learn that but little fruit set without their aid, owing to the scarcity of other insects so early in the season.

It has been my privilege to test nearly all the known races of bees, and I consider a good strain of Italian bees superior, not only on account of gentleness and honey-gathering qualities, but also from the fact that they resist bee enemies and disease better than any other race.

One or two such colonies are enough for the inexperienced to start with, while fifty or seventy-five are none too many for the man who has a knowledge of the business. Women make very good bee keepers, for the reason that they attend to all the little details; but they rarely do a large business as they seem to lack confidence, and when they contemplate an investment in this pursuit they usually ask the advice of an inexperienced man, who tells them that if they have made a little money they had better keep it. If the average profit in a given locality per year is $15 for five colonies, it is but reasonable to expect $300 from one hundred colonies, which we consider small enough for a fair locality for honey. Occasionally a location may be found where, owing to a great abundance of some particular honey-producing plants, a much greater number may be profitably kept.

I might here mention E. W. Alexander & Son of New York State, who keep about eight hundred colonies on one apiary, — their main flow coming from buckwheat, which is the principal crop of that section.

Bee keepers may be divided into two classes, — those who use single walled hives and winter in the cellar, and those who use double walled hives and winter out of doors. Whichever plan you adopt use some standard frame and section. Many of our most successful men use the Langstroth ten-frame hive and four and a quarter inch section and usually get a stock of all needed supplies prepared during the winter.

The first work to be done in spring will be setting the bees from the cellar to the summer stands. The time of doing this will vary with the locality and season. If the bees are uneasy in the cellar it will be well to select the first warm, still day in March to set them out. If, however, they are very quiet, it will be well to leave them until ten days or two weeks later. The most favorable place to locate a bee yard is where the soil is fertile and honey-producing plants abound, selecting a spot where the north and west winds of spring are cut off by woods, facing the hives south or east. It is quite a comfort to have some shade trees on the yard, to protect the operator in very hot weather, and they do not seem to lessen the crop.

If you run an up-to-date bee yard you will take advantage of the first honey coming in on a warm day, when the brood will not chill when taken from the hive, to clip your queen's wings. Half of one wing will be enough to prevent the swarm from going to the woods when they swarm, and by laying a piece of board from the ground to the entrance of the hive, the queen may be able to return to her home if no one is present to cage her and hive the swarm.

It is a mistaken idea that all colonies of bees on a yard should have the sections put on at the same time, as some of the weaker ones will not be ready for them until two weeks later, and you only allow the warm air to escape from the brood nest just at a time when they need it most. For the average bee keeper the old rule holds good: "Put on the sections when the bees whiten the tops of the brood combs." It is a wrong idea to refrain from boxing a strong colony in order to force it to swarm, as the bees clog the brood nest with honey, and thereby prevent the queen from laying her maximum amount of eggs, which later develop into bees that gather the harvest, so that the owner gets less honey and swarms than he would otherwise. One should be very watchful during the honey flow to see that each colony, as it gets its set of sections nearly filled, has it raised up and a second set of sections placed under the first, taking off the first as soon as completed, that the beauty of the comb is not spoiled by travel stain. It

is a great advantage when putting on the first set of sections to have three or four bait sections, or sections containing drawn comb, to put in the center of the super and so encourage them to begin work at once.

If you are located in a place where there is quite a honey flow from fruit bloom, dandelion or willow, before the main honey flow commences, it is well to put on a set of extracting supers, and put the comb honey super on later in its place. You will be astonished how they rush work in this super, and what beautiful honey you can secure. After removing those extracting supers they may be used to hive swarms on, or be disposed of in some other way. As the honey harvest draws to a close, you must put on additional sections sparingly, even going so far as to pick out a dozen finished sections from the center of the super and substitute empty ones. This we call weeding.

Of course, all sections should have a full sheet of section foundation, and all brood frames a full sheet of brood foundations, as by so doing you secure all worker combs and so avoid rearing a multitude of drones, to become consumers instead of producers, for bees can build comb more quickly if made drone size, but it is far from profitable to the owner.

If you conclude to produce extracted honey a very large hive is essential to get the best results. I would not recommend a hive or series of hives of a less capacity than 28 Langstroth frames, and would prefer them larger, having secured the best results with 28 Quimby frames, which is equal to about 37 Langstroth frames. Of course, if you do not restrict the queen by a queen excluder you will not have swarms, as some of the lower combs will be empty, and bees are not inclined to swarm when they are obliged to pass over empty combs when returning from the field. By this system I have produced as high as 4,120 pounds from 17 colonies, or an average of 242 pounds per colony, leaving over 40 pounds of stores to each for winter. No increase was made. Only one of them swarmed, and that was returned. The bees were kept warmly packed in early spring, and the brood was spread as fast as the cool weather would permit, putting empty combs

between combs of brood. This must be done carefully, or you will lose more than you will gain. As the honey is taken from the hive it should be stored in a warm, dry place, where neither bees nor mice can disturb it, being careful not to put combs containing pollen with those free from it, as the moth worms may not only injure those combs having pollen but many near it. Those having Italians will have little trouble from wax millers.

After securing a crop, the next work for the bee keeper, even though it seems very early, is to get all colonies in condition for winter by providing any that are queenless with a queen or brood or both, and any that are short of stores with plenty of food. This should be done by early feeding or equalizing stores. On a large yard quite a number will be found short of stores, while others have more than they need. By having all frames on the yard of the same size, combs of honey can be taken from the prosperous and given to those needing them. I have done this on a 200 colony yard, where the owner said 50 would have to be fed, and have, by a day's work, put all in such good condition that not a single colony starved during the winter. This was done without weighing. It is simply a question of good judgment. For the inexperienced it would be safer to weigh each colony, and allow 18 pounds of honey per hive for cellar wintering and 25 pounds for out-door wintering.

The proper time to put bees in the cellar, to get the best results, seems to be about the latter part of November, choosing a day of moderate temperature. The ideal cellar for bees is one where a temperature of about 45° can be maintained. Too much humidity in the air is bad, but this may be taken out by occasionally putting a bushel of unslaked lime in the cellar. If the cellar is too close, and the air becomes foul, the bees will set up a great roar instead of the gentle murmur one usually hears. This may be allayed by careful ventilation.

Several friends complained that their greatest loss in the cellar was on the row that set on the cellar floor. At my suggestion empty hives were used on the cellar floor to stand

the hives on which contained the bees, with very good results. Care should be taken that nothing disturbs them during their long winter nap. A few rats or mice will often disturb a hundred colonies, so that the greater part of them die.

No bee keeper can claim to be well informed who has not a knowledge of bee diseases, especially European and American foul brood. The former is more to be feared, although, if proper precaution is taken, this need deter no one from taking up the work. If I were to start anew again to-day in a territory threatened with disease, and had to buy my stock, I should buy Italian bees from a diseased territory and from a man who was careful and thorough, and should expect these bees to be troubled but little with disease, which is caused by a germ called *Bacillus alvei.* I should be on the lookout when handling the brood, to note if any of the unsealed larvæ had a yellow or brown color, instead of being pearly white. If so, I should expect to find others that had dried down to a dark and shapeless mass, which can be readily removed from the comb without destroying the cells. The dead larvæ give forth a sour, sickening odor. The time of death is when the brood is ready for capping, usually not afterward. Such is the appearance of European foul brood. It is also spread by robbing, bees of a diseased colony mixing with the adjoining one, especially if they are black bees. If, on the other hand, the race of bees is Italian, there will be little mixing, and consequently very slow spreading of the malady, for the reason that the Italian bees are great defenders of their homes, and no bees pass the guards at the entrance without a strict scrutiny.

It is for this reason that in an apiary containing pure black bees and pure Italian stocks you will find plenty of Italians in the black stock but no blacks among the Italians.

It took me several years to learn how disease could be communicated to an apiary two or three miles from the source of infection, but one day, after inspecting the only yard of Golden Italian in that part of the country, and finding them slightly diseased, I found many of these bees in a yard of blacks two or three miles distant, and nearly all of the twenty

hives of blacks were diseased. I question whether a bee ever goes from the diseased colony with its honey sack so free from honey that it contains no germs, and many of them, being driven by sudden storms and enticed by the hum of home-coming bees, may stop at any hive of black bees in their line of flight.

American foul brood may be in an apiary for several years without doing any particular damage to neighboring yards. Most of the larvæ die after the brood is capped, and the cappings have either holes in them or else are concave instead of convex. This kind gives forth a glue pot odor, and has a gluey consistency, often stringing out an inch when a toothpick is inserted in the matter in the cells. When dried this adheres so firmly to the cells that the bees cannot remove it except by tearing down the entire cell wall. This disease is also caused by a specific germ, called *Bacillus larvæ*. Both yield to the same treatment, — shaking all the bees from the comb on to clean frames having starters or full sheets of comb foundation, being very careful not to allow a single cell to remain in the hive for the bees to deposit the honey in that they carry with them, as it would contain the germs of the disease and the work would be in vain. The combs of brood from the diseased colony, or of several if you have them, may be placed in one or more hives and put over a weak, diseased colony to hatch, first putting a queen excluder over the weak one. This colony will be strengthened by the hatching bees and later may be treated as were the others. The combs should be carefully put where no bee can reach them, and may be made into wax.

In eleven years' experience I have never known a case of disease to originate from wax made from diseased combs. By Italianizing and this shaking plan, coupled with the work of the four inspectors, we have nearly eradicated this disease. During the past season I failed to find a single case of disease in any of my yards, which contain four hundred and fifty colonies. The yard that has had the least disease of any was one where all were of a vigorous strain of Italians. During the last seven years we have found but ten cases on this yard, and those were of a very mild type. I could cite numerous

instances from my personal experience, not only on my own yards but also in various parts of the State where I have traveled during the last nine years as an inspector, that show the superiority of the Italians where disease prevails. The poorest bees of all to withstand disease are the blacks, particularly where the strain is inbred and weak in vitality.

We have another remedy for foul brood when discovered too late in the season to use the ordinary means of treatment. If you have combs of honey free from the germs of the disease, these may be used to replace those in the diseased hive. This should be done after all the brood is hatched, and when spring comes you will find the brood healthy. The reason of this is that it is so late in the season that no brood is raised, and the germs infecting the larvæ are what perpetuate the disease. I once gave this remedy at the National Bee Keepers Association at St. Louis, and a gentleman from Illinois said that the information was worth many times the cost of his attendance.

Great good sometimes comes out of trouble. New York State has to-day better bees, better bee keepers, better methods and larger crops than it ever had before. We are more thoroughly organized, and the box hive man is now a curiosity. Much credit is due our Department of Agriculture for the assistance given at a time when it looked as though the means of livelihood of many people would be taken from them, as many men make bee keeping a specialty. The man with only a hundred colonies is not considered a large bee keeper, but it may provide him with the necessaries of life.

Perhaps I may here further trespass on your patience by saying something in regard to a system of apiaries. I have five arranged in a circle, which I visit either by driving or traveling on steam and electric lines. If I could give all my time to my own work I should use an auto, as many bee keepers use them to visit their apiaries, — one man traveling twenty-seven miles, where he has an out apiary which he runs for extracted honey, and many others a shorter distance from his home. We used to think if we ran an out apiary we would have to keep an attendant there during the swarming season, but we learned later to run it without swarms by having the

hives very large, and taking from them the surplus honey at the proper time. It was a great step, we thought, when we discovered how to run a yard for both comb and extracted honey with very little if any swarms, and visit the yard but once a week. The main feature was to get young queens laying in a nuclei, and after putting them in a regular comb honey hive, draw brood from the extracting hive and fill these hives full of hatching broods, putting on a set of sections. The queen being young, this colony would not swarm, but would devote their time to comb honey. There being such an abundance of combs of brood in the extracting hive at this time they did not feel the loss very much, and it rather discouraged swarming if they had such inclination. We now run several apiaries for comb honey exclusively, and by a visit of about once a week lose very few swarms, owing to having all queens clipped and looking over the brood frames of all colonies likely to swarm during the coming week. If any are found building queen cells they are made to swarm then and there by what is called the shaking off process, which, briefly told, is taking all the brood from the colony and replacing it with frames of full sheets of comb foundation. The brood removed is put in a hive by itself, and to prevent a swarm issuing, the cells are cut later, or, if early in the season, this brood may be divided among three or four weak colonies, to prepare them for the harvest.

It is quite surprising in some seasons that a yard only five miles away will secure honey on days that another does but little. By having apiaries four or five miles apart the average yield of the yards is better, for the reason that in a cool season those occupying the valleys seem to produce a larger crop than those along the hills, and *vice versa* in the warm season.

It just occurs to me that I have said little in regard to actually handling the bees. I usually handle them without veil or gloves, even on yards where the owners consider it unsafe to dispense with such protection. Some of these men believe that I have a preparation that I apply that makes me immune to stings. Such is not the case. It is only by understanding their likes and dislikes better than their owner.

Always use smoke in handling them, not too much, but just enough to keep them quiet. Do not handle them immediately after a long rain or on a cool day if it can be avoided. Do not jar the hives or blow the breath directly on them. Handle them carefully, and avoid crushing even a single bee, as the odor of the poison angers them. Avoid being nervous and be kind and courteous. By observing these simple rules a yard may be kept quiet and orderly often for the entire season.

In conclusion, I would say that I advise no one to embark in this occupation who believes in luck, or that he can succeed without hard labor and diligent study, but I know of no branch of agriculture that, for the capital and labor invested, pays as good returns, not only in dollars alone but in health and vigor, and the knowledge that your occupation is a blessing to your community, and that it brings you in close touch with that Infinite Mind who has placed in your hands His tiny workmen that will reward you according to your faithfulness.

Secretary Ellsworth. I hoped that there would be great interest in this bee session, for the committee thought it one of the prominent subjects that should be brought forth and discussed, not only because of the business of keeping bees and making honey, but because of the importance of having bees on our farms to fertilize the flowers of our various fruits. Another reason why this subject is brought forth is on account of the bee disease that is prevalent in a number of places in Massachusetts, and the committee thought it should be fully discussed. The bee industry is of greater magnitude than some of us are aware of. I had the pleasure of attending several bee conventions this last summer, and I learned among other things that tons of honey are being made and sold on the market at a great profit.

Question. Is there any danger of hurting the bees or the honey by spraying fruit trees with arsenate of lead, etc.?

Mr. Stewart. There has been in New York State some instances of harm and great damage to surrounding apiaries. Of course the fruit men did this unknowingly, perhaps; but it seems, if I understand the fruit question right, that just

at the time when the bees work on the blossoms is not the proper time to spray. But some of them, not understanding that, sprayed at a time when they should not have done so, and the result was they injured themselves, not only in the crop of fruit, but also by destroying their co-operators, the bees, that fertilize the blossoms, that carry the pollen from flower to flower.

Question. Can you tell what is the better way to winter a lot of bees out of doors in single hives? What protection would you give them?

Mr. Stewart. I am not familiar enough with Massachusetts to know how severe your winters are, but in New York we should not consider it safe to winter them in single wall hives out of doors without protection. There are two ways in which this can be done: by setting in a box and packing this box with plain shavings, leaves or something of that nature, and excluding any water by covering it in. Another way is, if you have a row of hives a short distance apart, to set some sticks in the ground and have a row of boards behind them, and also some in front, and pack with straw or leaves, which makes a nice packing, and is one of nature's own devices for keeping the frost out of the ground, if you use a liberal supply of it. After packing these leaves all around, over and in front of it, be sure to leave a little bridge, so the bees can go out and in. When the temperature gets to 45° the bees will fly, and get back to their hives as soon as a wind comes up. Being wintered out of doors they get the benefit of several winter flights, cleansing flights, which are very beneficial. Your packing is around them in the spring, and you won't need to unpack them until the cold weather has passed by, and they will get along more rapidly than in the cellar.

Warmth is a very essential feature in the spring of the year. Some men use a paper cap the size of the hive, like the hive, that slips down over the top, just leaving a little space for entrance; and this paper, being so constructed that it is pretty near air tight for practical purposes, holds the heat in.

Question. Which have you found the more effective, the

educational or the legal aspects of the New York State law, in the suppression of bee disease?

Mr. Stewart. That is a hard question. I think I should have to say the educational, although the two should go hand in hand. In the nine years in which I have been inspector, I recall but one or two cases where I had to exert my authority to get the work done. I have talked to them, and by tact and diplomacy I have brought about desired ends; even when I have destroyed some of their bees I have done so with their consent. Right here I want to say that the only way to rid yourselves of bee disease is by having a proper law passed and getting a proper man to enforce it. He should be a man whom you have confidence in, and he should not be handicapped by being obliged to ask permission to visit a man's bee yard; he should not be restricted in any way; he should have access to those yards at any time. It is necessary to give the bee inspector this authority. If he abuses it, or fails in his duty, he should be removed.

Mr. Wilfred Wheeler (of Concord). Is there any objection to keeping bees in a barn? I have a room in my barn where I keep a few hives of bees, making an opening in the side where they can fly, and a door on the outside. I have been troubled with the bee moth, and have had the bees die in the winter, — not from lack of honey and apparently from no cause whatever.

Mr. Stewart. In a building that is open, that is not heated in any way, above ground, unless there is a large number in it the average loss is very great. I have known of a man who wintered bees one year in a hop house (which is like a barn, only it is fairly tight). He wintered them fairly well; the next winter he lost all but one colony. Having so much space they suffered more than if they had stayed out of doors, and had the protection of the snow. All of my bees are wintered out of doors, and you will always find the snow drifts over them, and the snow keeps them warm. The heat of the bees will melt the snow around the hives. But they all have to be shoveled out in March and given a flight. Sometimes we are not able, in setting out yards, to get protection of woods

on the west side. We do not go to the trouble of putting up a fence, but heap the snow as a fence for them. I don't think wintering bees in a barn is very good policy.

Mr. Wheeler. I should like to know about the drones, how many are necessary, and the control of them when they seem to get too numerous.

Mr. Stewart. Of course a colony, under normal conditions, will vary greatly in the amount of drone comb they build. If you allow them to build their own combs entirely, especially if there is an old queen and a strong colony, they will build a great amount of drone comb, for the reason that they build it much more quickly than they can the worker comb. And after they have built it, they begin spreading out a little, and this drone comb is in the way. The drone flies out and comes in with a great appetite, and you raise these drones with a great deal of expense, and after you raise them you have got them on your hands; and the bees will keep them right along up to the time the honey is cut off, and then, of course, they push them out, and worry them until they drive them out and starve them. The drone has no pollen basket or honey sac; no means of labor. I try to impress that on my wife, — that man was never intended to work any way, citing this as an instance. On the drones' account a colony has all it can do to build its own combs, and for that reason we use full sheets of comb in the frame. Of course the bees will get all the drones they need; even at that they will build more drone cells on to the worker comb, but they will get all they need, you need not fear. Now, as to controlling the flight of drones; that is a pretty hard matter. The queens go but a little way from the hive, but the drones go two miles often; and that is the reason a long series of experiments have been conducted for mating. That, of course, is another branch, and a lot of work is being done in the experimental line on it.

Prof. J. B. Paige (of Amherst). Mr. Chairman, have Mr. Stewart give us the best methods for the prevention of swarming. Our difficulty here in Massachusetts is this: when our bees reach a certain stage of thriftiness in the hive, just as the white-clover flow starts in, they get the swarming fever, and

we get from one to two or three swarms through the white clover season; so we have got weak swarms, but no surplus honey. We could get honey if we could suppress swarming.

Mr. Stewart. The method of holding down swarming is simple, in procuring extract of honey, because you are not exposing the bees to crowded conditions; but with comb honey it is a different matter; there must be a certain amount of crowding. And the main point in that is this, as I suggested to you in my paper, and you will find if you were to submit this or leave it to any man that is well posted in bee keeping, — there is a whole lot given in a few words there where I say use bait sections in the center of the hive, and put them on early, so that there is no danger of crowding that queen, and not reducing her cells to lay in, for it is very essential that she be given lots of room. But you want to put this super on in time if you want to catch the honey. After they once get the idea fixed in their minds they will go at the queen cells; so I would rather they would swarm once than loaf around. If you can put those bait sections in, within two or three hours or four or five hours you will have honey in them, and they will draw out the foundations and fill up rapidly, and just as soon as it is two-thirds or three-fourths full, if you will raise it up and put another one in it will reduce the swarming. They will forget the swarming and be content, and from those colonies you will get a great amount of surplus honey. If, on the other hand, after they have filled two or three supers they want to swarm, you can divide them up by taking brood or queen away, or allow one natural swarm, and the seventh day leaving the thriftiest one. If the queen has escaped from one of these cells you cut all the cells. After the queen gets out it is only a question of hours when they will all go out. If you cut them as soon as the swarm issues they will construct others. So about the sixth or seventh day we cut them, so that does away with any second swarming. Ventilate your hives in hot weather; lift them up on pieces of wood. Shade is a fine thing. See that they are comfortable. But if you allow them to clog the brood nest with honey and sit in the sun with no shade, it gets so hot and uncomfortable they are almost driven to swarm.

Question. What would be your idea, when the second swarm comes out, of destroying the queen and letting the bees go back?

Mr. Stewart. If you destroy the first queen and let them go back, perhaps the next morning they will have a new queen, and go out again. Although sometimes, if you allow them to go back, they may change and allow the queen to bite all the cells. And sometimes, if the weather is bad, they put a guard around these cells and keep the queen away. And the queens in the cells, you can hear them piping; they allow them to cut a little hole and run their tongue through this little orifice, and they feed them, and keep them a few days. Sometimes, when weather conditions are hard, you will find three or four such queens. In an Italian yard, when we want these new queens for mating purposes we take them out and put them in a new yard and mate them. If you put in unsealed larvæ with but one virgin queen they will destroy her. But after she is mated, you can put in any kind of broods you choose.

Mr. Wheeler. Will you tell us the best honey plants suitable for honey, besides the white clover?

Mr. Stewart. White clover for years has been a rather shy yielder. We still have white clover, but it does not seem to yield the nectar. Now we have more basswood than we have had in some years, perhaps 100 acres, but it has yielded sparingly for several years. It runs in series, and I expect in a few years it will begin to yield again, as will also the white clover. Our farmers are raising a great amount of alsike, and it produces a very fine quality of honey.

Mr. G. E. Taylor (of Shelburne). It is some years since I have done much in bees, and for that reason perhaps I am out of date. But this matter of swarming is one that will try a man's ingenuity as much as anything he can engage in. Bees are very cunning and wise things, and you have got to know a lot about them. I used to do several things to hinder their swarming as long as I tended right to the matter. In the first place you want to give them ample room to work. Put on boxes early, and that gives them a chance to work in enough room, and perhaps will delay the swarming some. But to be

effectual these frames have got to be examined once a week sure. Examine carefully, and cut off every queen cell, if you don't want to have them swarm. If you find that they are determined to swarm, open the hive and take out two to four frames and put in some new ones. That will usually stop them for the time being. What will you do with these frames you have taken out? If you have taken outside frames, there is generally not very much brood in them. If you take out broods, start a new hive, a new swarm. Take a new hive, and put in say two or four frames that you took out of this full hive; then go to a hive that is running all right and take out another frame, and let them raise a queen of their own, and they will go on and build up a swarm themselves.

When I began, I began under compulsion. Our family wanted a swarm of bees, and I didn't want them. But a swarm of bees must be had; so I paid $7 for a swarm and got a new hive. That year was a poor year, and I got one swarm of bees; and they got through the next winter without any honey to start them in the spring. So I fed them some dissolved granulated sugar, and got them well started; and we had another dry season, — didn't get very much honey. But the next year I got two more swarms, and it was a grand, good season; and from those four swarms of bees I sold $75 worth of honey. Well, I took care of them just as I would a flock of hens or a herd of cows or sheep. That's the secret of the thing, — tend them. I got more from those four swarms that year than I did when I had sixteen. What is a good food for them? Fresh white clover and basswood. I believe those four large swarms gathered the honey for their food in better proportions than the sixteen did. So if I were going to raise bees (unless I wanted to sell bees for market, which is the most profitable, I guess) I'd keep the swarms down just so I could take care of them well, and not have any more.

Something has been said about wintering bees. I used to put mine in a dry-goods box, and pack it with leaves and one thing and another, and I used to have mice come in and eat up a whole swarm. I had to have it fixed so a mouse couldn't get in. I had just as good luck from wintering bees out-

side of a box as in. I used to put them in the cellar, where they got disease; that wouldn't answer. I don't care if the snow drifts over them; just keep them warm. I wouldn't have them in a barn; they are filthy things. If you put the hive down low, six inches from the ground, they come in from the field laden, and they want to strike the hives as soon as they can. Well, there's lots of things about bees, and a man may work at them all his life and he won't know all about them.

Mr. Stewart. About having them six inches from the ground, that is essential, and what the gentleman says about looking after them is to the point. It isn't always the lack of knowledge; it is applying what you have. In regard to taking some frames out to prevent swarming, that we call dividing. We take some frames out and put them in a hive by themselves, and give them a queen cell already capped from some desirable strain.

Afternoon Session.

The meeting was called to order at 2 P.M. by Secretary Ellsworth, who introduced Burton W. Potter, Esq., of Worcester as the presiding officer of the afternoon.

The Chair. You probably know that I am interested in cows. Our lecturer of the afternoon, Professor Dean, is well known in agricultural circles in Canada, and especially in the Province of Ontario. He is an authority on all matters relating to the dairy cow, and it gives me great pleasure to introduce him at this time.

THE COW AND THE MAN — THE TWINS OF THE DAIRY INDUSTRY.

BY PROF. H. H. DEAN, ONTARIO AGRICULTURAL COLLEGE, GUELPH, CAN.

Dairy problems of whatever nature resolve themselves at the final analysis into one or both of the two factors which we have chosen for our heading, viz., "The cow and the man." We have chosen to call them the "twins" of the dairy industry.

The Cow.

When we consider that a cow is able to produce from ten to twenty times her own weight of milk annually, and more than half her body weight of milk fat yearly, and that the milk and the oil so produced are among the best and most healthful of human foods; and, further, when we consider that she can easily produce in a year her body weight of cheese, — one of the best of known foods for building muscle and furnishing human energy for work, — when we think of these things we marvel at the power and capacity of the dairy cow.

We may inquire at the outset whether or not she always possessed this wonderful power of transforming coarse feed into human food, or if it be an "acquired characteristic." We have every reason to believe that the cow in the early stages of her history produced no more milk than was required to give the young calf a start in life. After this was accomplished she weaned the calf and gave attention to the recuperation of her own body and vitality. At this point man stepped in and became a partner of the cow. It is a question whether the man took in the cow, or the cow took in the man. We have reason to believe that both have been "taken in" at various

times and places. In fact, it is altogether likely that this same game is being played to-day. There are men who are being deceived by cows and there are cows which are being deceived by men. When these two are mutually helpful to each other, we have the best results. But we are getting ahead of our story. Let us go back a short distance.

Just why man selected a cow in preference to any other animal, *e.g.*, sheep, goat, mare, reindeer, — all of which are used in some countries for milking purposes, — will doubtless be a mystery always. There must have been some affinity between the man and the cow. With the right type of a man and the right type of a cow we believe that this affinity exists to-day. But there must have been some special reason for man's selection of a cow for the great purpose of milk production and the saving of the human race from utter extinction, as would undoubtedly have been the case before this had not the cow come to the rescue of mankind.

Variation the Probable Cause for Man's Choice of the Cow.

We have no means of knowing for a certainty, but we believe the cause of man's selection of the dairy cow for purposes of milk production lies in the fact that the cow possessed in a marked degree the inherent quality of variation. By instinct, or reasoning, or by some other means, man discovered that the cow could be trained to produce a large quantity of milk, — larger than any other animal known to man. It is altogether likely that he tried his skill on the sheep, the goat and on other animals, but the response was not sufficient to warrant men in large numbers continuing experiments on an animal so " sot " in its ways. The cow responded freely to man's efforts at improvement. From an animal with probably but two teats and a small udder she developed into an animal with four, six and eight teats, and with an udder so large that in some cases it is a burden to carry. At the same time the quantity of milk given is astonishing. A Canadian auctioneer at a sale of cows which we attended not long ago said that the only reason the owner had for selling a particular cow was

that he (the owner) had to take out a washtub every time he milked the cow (ordinary milk pails would not hold her milk), and the washtub was inconvenient to carry to the stable. This was probably an exaggeration, but it serves to emphasize the milk-producing capacity of the modern dairy cow.

That man was early impressed with the value of cows is indicated by a recent discovery of a perfectly preserved shrine and image of the Egyptian goddess Hathor. This shrine dated probably fifteen hundred to two thousand years B. C. We read: —

> The shrine in which this particular cow goddess was placed was a cave about ten feet long and eight feet high, cut into the solid rock and lined with slabs of sandstone. This sandstone, which is covered with sculptured designs and inscriptions representing the king and his wife in various acts of worship toward the goddess, had been used evidently because the native rock was of a marly nature and could not be brought to a smooth surface. There was nothing else in the chapel when it was discovered save the cow and the sculptured sandstone walls.

We thus see that in very early days, among a people noted for their advancement in wealth, learning, art, science, manufacture and all that goes to make a nation civilized, the cow was worshipped by kings and queens. (We also note that the cow was kept in a cave. Some men follow this idea to-day, to the disadvantage of both cow and man.) We read further: —

> The cow, like the slabs of the chapel, is of sandstone, cut out of an enormous piece of stone the full thickness of the animal and sufficiently high to reach to the top of the plumes on its head. The figure is of natural size, and the shape is said to be a perfect likeness of the cows of the present day, though the body seems to be straighter and thinner than is natural. The color is reddish brown, with spots which look not unlike four-leaved clovers. The head, neck and horns of the cow were originally covered with a very thin coating of gold leaf. The goddess is represented as suckling a boy and protecting a man who stands underneath her neck. Both these figures are no doubt intended to represent the king, the idea intended to be conveyed being that Hathor was the divine mother of the king, that had nourished and was still protecting him.

Is there not here sufficient data to found a romance of the dairy cow? If we were a novelist or had powers of description like a Winston Churchill (American) we should try to show that the modern cow has doubtless developed in depth and width since the days of the Egyptians, 1500 B. C.; that the spots resembling four-leaved clovers which adorned the skin of the cow were intended to represent the close connection there is between cows and clover. (We are surprised that an ear of corn or a corn stalk was not found in the cave, but possibly they did not grow Indian corn in Egypt. In fact, we are almost sure it is an American product.) The gold leaf on the horns doubtless symbolized the fact that the cow was a great wealth producer, — the Egyptians having so much that they put it on the horns of cows. In these modern times we spend it on automobiles and airships, etc. Again, is not that a truthful and beautiful representation of the modern cow in her relation to man, — suckling the boy, protecting the man! Is that not her position to-day? But we must call a halt on these fancies, else we shall stray too far from our subject, which is practical not poetical.

Man, then, has developed the cow by a system of selection, feeding and training for a special purpose. Owing to the tendency of all animals to revert to their original type and characteristics, and the cow being subject to the same law, we can keep the cow up to standard and improving only by continuing the processes of selection, feeding and training for a special purpose. Especially ought we to keep a sharp lookout for the mutants, sports or variations in our special direction. These are the gifts of nature to a wise man. How many are so blind that they do not see them!

If the foregoing reasoning be correct, it excludes the idea of dual-purpose, triple-purpose and all other purpose cows, except the one purpose of milk production. While it is true that dual-purpose cows are found among some breeds and in some districts, when the question is carefully looked into these animals are usually kept for one purpose, and the others are merely incidentals.

Training of Cows.

One of the chief rules to be observed in training cows is the rule or law of kindness. Do unto cows as you would have cows do unto you is a rule which ought to be prominently displayed in every cow stable. Study cows individually as well as collectively. Keep a record of food cost and milk production of each cow in the herd. The use of a scale or spring balance, together with a Babcock test for fat, is highly recommended to every dairyman. Where individual owners cannot for any reason do the testing, join a cow-testing association, if there is one in the locality. If there is none, form one. Your State officers will help you.

Under this heading we would include also the feeding of cows. I think I need not go into details on this point. A few simple rules will guide us. Nature's food for milk production is grass. In the compounding or making of a ration for cows follow nature as closely as possible and we shall not go far astray. Make the winter feed succulent by using corn silage and roots along with coarse, dry fodder and meal or concentrates. Give a cow all she will eat of the cheap, bulky food, but feed the meal according to the milk flow, if the cow is in good condition, unless there be some special reason for feeding an extra amount of meal. About 8 pounds of meal daily is about all that the average cow can profitably consume. However, the feeder must use his judgment, make a few experiments and note results.

A wise dairyman prepares for summer droughts by having some corn silage left over at the beginning of spring; or he may grow soiling crops, or an annual pasture crop. In Ontario, Can., the best soiling crops are peas and oats, clover and corn. A good pasture crop to supplement grass is got by sowing oats, 51 pounds, early amber sugar cane, 30 pounds, and red clover, 7 pounds per acre. The crop is ready for pasture in about six weeks after sowing, in northern latitudes.

As a rule, we think it pays to cut coarse feed and grind all grains before feeding them to cows. Feed regularly and with good judgment. Mangers or feeding places must be kept clean

and sweet. Water and salt are necessary. Above all do not stint the cow when dry. This is the time for her to renew her vitality and prepare for the great strain of next season. She ought to be dry for about six weeks and be well fed during that time.

The Man. Some General Observations.

What about the other twin? What shall we say of him? Bacon observed in his time that "Children in dairy districts do wax more tall than where they feed on bread and flesh." Carlyle lamented that the best milk in the country districts of Scotland was being shipped to the cities, and the children were fed on "slops," as a result "the breed decays." Justin McCarthy says: "The word dairy is derived from the old English word 'deye,' signifying a maid, and which with slight alterations became a word of endearment, and thus gave us the growing young woman as the central figure for the production of milk, butter and cheese."

Dairying and the development of the highest type of manhood and womanhood have always been closely associated with each other, hence we offer no apology for linking the man and the cow at the present time. We believe that man is the highest product of the evolutionary forces which have been and still are at work, but whether or not he represents the highest type of being possible who can say? Be this as it may, we believe the dairy cow holds a very high place in the scale of development below man. By co-operating with the cow, man has been able to achieve marvellous results on the farm. For our purposes mankind may be divided into two classes, — farmers and non-farmers, — with a possible third class who may be called part farmers and part something else. Some one has said: "Americans are divided into two classes, — the farmers (60 per cent) and others (40 per cent)."

We believe that farmers are not getting a fair share of the profits which ought to come to the tillers of the soil. This is accounted for, to some extent, by the fact that farmers as a class are too much inclined to allow the "other fellow" to take the cream, while he (the farmer) is willing to take what

remains. The time has come when farmers may justly say to the other classes, "Come now, let us reason together! We are carrying too large a share of the burdens of taxation. Why should we be taxed to benefit infant industries?" I fancy I hear some wealthy manufacturer, whose goods are largely used by the farmer, and who enjoys from 35 to 50 per cent "protection" from foreign manufacturers, say: "What are you farmers grumbling about anyway? You have a better time than I do. You are free from business cares and worries. You are your own boss," etc. These remarks remind me of an incident which is said to have occurred during slavery days, "befo' de war." Some of the colored slaves on a certain plantation were grumbling about their lot, wanted to be free, etc. Their owner turned to them and said: "What are you grumbling about? You niggers have a better time than I do." "Yes, sah, that's so," said an old darkey, "so does your hogs." This, some one has said, illustrates a saying of John Stuart Mill: "Better a dissatisfied man than a satisfied pig."

To show the importance of the American farmer and his products, and how small a proportion of the revenues of the great United States is spent on agriculture, a speaker recently made the statement that in ten years (1896–1906) nearly 60 per cent of the value of the United States exports came from American farms, and less than 1 per cent of the federal revenues were expended for the benefit of agriculture.

Some one has said: "The well-being of a people is like a tree, — agriculture is its root, manufacture and commerce are its branches and leaves; if the root is injured the leaves fall, the branches break away and the tree dies." This illustrates the value of agriculture to any nation. 'Tis doubtless true that "the farmer feeds them all," but it is also necessary that the farmer himself shall be well fed, mentally as well as bodily. There has been a tendency towards *starving the mind* on many farms. Farmers are working against great economic disadvantages. In both Canada and the United States the economic conditions are fixed against the farming classes. Farmers work hard, but until these economic handicaps are removed they will be unable to make much progress. We

read recently of a party of visitors who were going through an asylum for lunatics. One of the party said to an attendant: "How do you know when a patient is cured?" "That's easy," said the attendant. "We set them baling out a trough of water which is being filled all the time from a two-inch pipe. When a man knows enough to shut off the water before he begins baling out, he is sufficiently cured to leave the institution."

Farmers are in a similar position. Until they are sufficiently enlightened to know enough to turn off the streams which are drowning them, in spite of frantic efforts to swim out, they may be scarcely considered in a fit condition to control the affairs of an agricultural nation, which is their right according to numbers. We may not in America reach that happy condition described by an English poet who said: —

> Ere England's griefs began
> When every rood of ground maintained a man,

but we should probably approach the state described if farmers had a "fair show." Why should they not receive more attention at the hands of the gardeners of the North American continent? 'Tis true that "Of all the flowers, the flower of humanity (the farmer) stands most in need of the sun." Farmers have been too long "in the shade."

The farmer owns land, has the labor and some capital, hence possesses the three requisites for the production of wealth according to the rules of political economy. The other natural agents, such as timber, coal, minerals of all kinds, gas, oil, etc., belong, or should belong to the people as a whole. As farmers represent the largest number of any one class of the people in America they ought to be the largest sharers of the wealth produced in our country. Too much emphasis has been and is being placed upon manufacture as a means of acquiring wealth. A French writer says of the manufacturers of the United States: "At the present moment it looks as though nothing could stop their progress. They are rushing through space like a cannon-ball." But in case manufactures fail, he says: "They have but to hark back to agriculture, — a less

fruitful industry but more safe and more lasting. They [United States] can, in consequence, face the future with more serenity than any other country, provided only that they are not intoxicated by success and do not want to dominate the world." (Meline in "The Return to the Land.")

The afore-mentioned writer deplores, as do many others, the great rush from the country to the city, which seems to characterize nearly every country. All these things tend to sap the life of the farm.

Suggestions for the Man on the Dairy Farm.

We shall conclude with a few practical suggestions more particularly adapted for "the man beside the cow." To the young farmer we should say that the first requisite for success in farming or dairying is to obtain an education. One of the old Grecian philosophers said: "My mind to me a kingdom is." How many realize the value and importance of the kingdom of the mind? Goldsmith said: —

> Experience proves in every soil,
> Those who think must govern those who toil.

We frequently say to our students there are not more than two things a young farmer is justified in going into debt for. They are, first, to obtain an education; and second, to buy a home. There are many young men on farms to-day to whom an agricultural education would be of more benefit than any other one thing they could possess. Some one has said: "There are two most valuable possessions which no search-warrant can get at, which no execution can take away and which no reverse of fortune can destroy; they are what a man puts into his brain — knowledge; and into his hands — skill." These two — knowledge and skill — are the master possessions of the dairy farmer.

We should advise, if possible, a course at an agricultural college, of which there are a number of excellent institutions all over the North American continent. Here, contact of mind with mind sharpens a man's intellect in a way which otherwise can not be done so well. "As iron sharpeneth iron,

so does a man's countenance that of his friend." If this is not possible, we should strongly advise a course of reading. Dairy and agricultural journals, agricultural and dairy reports, bulletins, etc., may now be got for a small sum. No man need be without the means of obtaining an education. Books on nearly all phases of farming may be bought at small cost or had from circulating and free libraries for a small fee. He who earnestly desires an agricultural education may gratify his wishes at little expense in these times of great expansion of agricultural thought and practice.

In addition to reading, a man needs to think deeply and act wisely. Digestion and assimilation of mental food are as essential for the well-being of the human mind as are the proper digestion and assimilation of food for the welfare of the body. There are men who seem utterly unable to put their knowledge into practice. Such men become marks for the shafts of witty workers, — men who do things. Knowledge of soils, plants, animals, and their relation to each other, is very important, but the man who cannot set these natural materials and forces to work in such a way as to achieve practical results is voted a failure by the practical man on the farm. It is at this point where so many college graduates fail.

In addition to all this the farmer of to-day must study the questions of economy of transport and the best methods of buying and selling. Good roads, fair transportation rates on farm produce, efficient transportation, and how to buy and sell are essentials in modern farming. Meline says: "Efficient selling is essential to any industry that is to be prosperous; its profits depend on this."

Farmers need to develop independence and co-operation, — two qualities more or less antagonistic, yet essential for the highest development of farmers and the farming industry. Be not mindful of the men who "work the farmer" instead of the farm. Do your own thinking! It will then not be possible for any one to say, O foolish farmers, who hath bewitched you?" The cow and the man will make a strong team wherewith to lift agriculture from the "slough of despond" into which many farmers have fallen.

Mr. P. M. Harwood (of Barre). A year ago we had a lecture from Prof. Thomas Shaw on the subject of breeding, and he spoke about the law of like producing like, and also a little about the law of variation. There is some difference of opinion, apparently, between Professor Shaw and Professor Dean, and I think if the lecturer would enlarge a little on what he said about variation he would make it more clear to the audience. I know they sympathized with what Professor Shaw said last year, and I remember calling attention to this other law of variation.

Professor Dean. You understand that that is a very wide question, and in itself would take up all the time allotted to the lecture. But, in a word, we have these two laws at work. In the breeding of all kinds of animals the old law was that like produces like. This law has been called the keystone, the cornerstone of the breeder; and, to a certain extent, of course, that law does apply within certain limits. But, strictly speaking, like never produces like. The observing man must come to the conclusion that nature abhors sameness; that she never produces two plants or animals alike; she loves variety.

A farmer who is watching his herd, and giving it daily inspection, will find, for instance, that a certain animal has the power to produce animals which are heavy milkers, or large butter producers. That is a variation from the normal, because the normal power is to give the calf a start, then the cow dries up. Some men who are breeding pure-bred cattle will give much attention to a fine horn or a certain color; and they will weed out all cows that have not the horn just so; or a tongue of a certain sort; or a black switch. The probabilities are that the men who are doing that are destroying in many cases animals which have the power to produce the largest quantity of milk and butter. They have sacrificed them to that fad called form. We must study this law of variation; we must get it fixed definitely in our minds what we want to do, what we need; get the cows that are varying in the direction we want. It is all right in itself to want cows all of a certain shape or color, but I think it would be much better to breed them upon lines of production.

QUESTION. When it comes to color of horns or skin, those points are of minor importance, but when it comes to form production, haven't you created a wrong impression?

Professor DEAN. I have studied that question. I know some men think if you get a cow with a wedge shape and prominent backbone, a bright eye, and all those other points, she'd be a good milker. I want to say from my own experience with buying, breeding and raising cows, that I have seen good cows of all kinds of forms, — that is, in the general form of cows. We have a cow that gives 21,000 pounds of milk, over 900 pounds of butter, in a year, and that without her having the so-called V form. I think too much emphasis has been laid on this matter of form.

I grant that men have become expert in picking out cows. They have, by an intuition, a something that is very hard to define, been able to select good cows. There are certain things which guide a man, of course. There are many men, however, who will select cows according to form, who will never weigh and test the milk. Is there any association in this country that will allow a man to put cows in the advanced registry according to form? I don't think there is. That, to my mind, is practical proof that the form theory falls down, because no buyers of dairy stock that I know of will accept animals in advanced registry by their form alone. They must be able to produce the goods. We arrive at that result by using the scale and the Babcock test. Form is all right for certain men, but is of little use for the great mass of dairymen.

QUESTION. How many seasons did that cow produce 900 pounds of butter?

Professor DEAN. Just one season. This was her second calf. She is a good cow to-day. I see no reason why she should not beat that record.

Mr. JOHN BURSLEY (of West Barnstable). You spoke of the Babcock test; that it is better than some old fellow's judgment. How does it happen that you have so much trouble about getting the same figures one day as another? The test will come back 15 or 20 one month, and 20 or 21 the next month; and a man is feeding his cows just the same, giving

them the same care. Isn't there a little hitch somewhere in the Babcock test?

Professor Dean. You have mixed two things; you have mixed the test of the cow and the test of the cream. Cows vary in their milk. I may test a cow this morning and find her milk tests 4 per cent fat. I may test it to-night and find it 3.6 or 4.5. Why it is so I could not tell you; it is a fact. And it is not the fault of the Babcock tester; it is the fault of the cow. If you will weigh the milk you will find that cows very seldom give the same amount of milk; they vary in the weight and in the tests, but why they should do so I do not know, no more than I know why the color of my hair is what it is.

About this other question, the test of the creameries, there is where the man comes in. It is not so much the cow as the man. Suppose you have a separator, and you try to turn it just as evenly as possible. Every time you try the separator there will be a variation. Why? It depends upon the amount of fat in the milk, upon the weight of the milk in the supply can, upon the variation of the speed; and that affects the percentage of fat in the cream. It depends upon whether the cream outlets are open or clogged. The Babcock test will tell you the percentage of fat there is in that milk or cream, but the cow causes the variation, and the man doing the separating will cause a variation. Therefore you will never have the same percentage of fat in the milk from day to day or month to month.

Question. Professor Dean says they have many cow-testing associations in Canada. Will he tell us how they are started, how they are operated; what the expense is, etc.

Professor Dean. We have cow-testing associations in several provinces in Canada which are under the supervision of the government, — a very paternal government. It is doing things for our farmers which, in some cases, it would be just as well the farmers did themselves, because they have to pay in the long run. The association may consist of three men, or as many as fifty or sixty men living in a locality. The farmer supplies a pair of spring balances, with a dial scale;

undertakes to weigh the milk from each cow night and morning, and to take a sample from each cow's milk at least once a month, night and morning. And the association takes samples for three successive days. Then these samples are sent to a central point, — usually a cheese factory or creamery. There a supervisor sent by the government tests the samples of milk, and reports to the farmer each cow's test. The farmer sends to the Department of Agriculture a record of the weight of the milk; then this is sent in by J. A. Ruddock, Dairy Commissioner, Ottawa. That part is under the direction of the federal part of the government. That costs the farmer nothing. The farmer weighs the milk, provides the samples and provides the scales. There are other phases of this work. If the farmer wishes to conduct yearly tests, then the government sends a man to this farmer's place, sees the cow milked, weighs it, takes samples, tests that; and this is used as a basis for the year's production of that cow. But he visits the farmer only once a month during the year. But suppose the farmer wishes his cows tested frequently for seven or thirty days, and have a supervisor there all the time, — which, you understand, is an expensive process. For this he pays $2 per day for the services of a man sent, and his traveling expenses. Now, in that case there is no doubt about the record. In the other two cases there is room for doubting the record. But there is no advantage to the farmer in cheating himself. But where the tests are given by the association, then we must have this work exact.

Prof. Wm. P. Brooks (of Amherst). I made up my mind I was not going to say anything, because I want the other people to do the talking. But when the presiding officer touched so pointedly on the cow-testing association, the temptation was more than I could resist, because I am so heartily in sympathy with the idea of cow-testing associations; and I believe that it is high time that we here in Massachusetts took some definite interest in that matter. Professor Dean pointedly alluded to the necessity of weighing the milk and testing the milk in order to find out concerning the productive capacity of the cow; and that is true. While I think he did

not touch quite enough on that subject, I am a little more conservative than he is on the dairy "form." It is true that the cardinal principle consists in finding out the productive capacity of the cow, — whether it cannot be found out from the form, the wedge shape; but it must be found out only by the scales and test. Here's a point, and it is a painful one, put in the form of the question: How many farmers, how many producers of dairy products, whether milk or butter, in the State of Massachusetts know the number that are paying them a profit and the number that are paying them a loss? There are some very shrewd men, shrewd observers, who sell milk and have milked, who can tell pretty closely about what a cow is producing in a year. But I venture the statement that three-fourths of all the farmers dealing in milk in Massachusetts do not know, in their individual herds, which cows are paying a profit and which a loss. Now, there are a good many things which cause agriculture to be a hard field from which to make a living, I grant that. But if you are going to carry on your business in that way, I want to know how you can expect to make a success of it? If that is true — that the farmers don't know which are paying a profit and which a loss — isn't it about time that they found out? Now, then, there comes the cow-testing association. The "New England Homestead," through its very energetic assistant editor, has made a precedent, and determined to organize this association in Massachusetts; but, so far as I am aware, none has been started yet. Last spring I prepared a circular, in order to give very briefly, in outline, how the farmer could help himself by testing his own cows, by weighing his own milk at home; and I have had some applications for those circulars. This fall I thought it would be a good idea to interest the creameries of the State; and therefore I wrote each one of them a personal letter, and said: "We have prepared a circular on this subject, and will supply these to you at cost, which is very trivial. I wish you would see if you cannot take some of these and distribute them around among your patrons, and see if you cannot interest them." Not one reply have I had to that circular and the personal letter accompanying it. I

don't suppose the farmers are very much interested in finding out which cows are profitable and which are not. Yet if I sent out a letter saying that I would give every farmer a certain amount of money if he would do this, I presume my table would have been deluged with letters. I believe thoroughly in cow-testing associations, and I believe it is necessary for some power, some authority, to take hold of this subject and push it. In Canada they have the general government. Some power must take hold of it and interest the farmers; make a personal canvass and show them what the object of the organization is; and then, it seems to me, they ought to be willing to pay at least one-half of the cost, if not the whole cost, which can probably be reduced to a very small amount. I am not as much a believer in the very low cost of these tests as some others. I have figured it out, and I think with the conditions in Massachusetts that one, two or three dollars a cow would do. I cannot see how it can be done for less than a dollar.

Question. Is the 10 cents per cow you referred to on the number of cows belonging to those in the testing associations, or the total number of cows?

Professor Dean. It was assumed that, if they could get a sufficient number of farmers, and I think about 500 cows to the association, that 10 cents per cow would pay the actual cost. I am not sure, but think the government purposes to pay the services of the official tester, that is, the expense of getting a man to do the work. I do not think your State officers could employ any funds they have to better advantage than in working out some such scheme as that, and controlling the work, and putting the cost to the farmer down as low as possible, because I realize that every dollar the farmer gets means more to him than to a professional man or a manufacturer. When the farmers realize the actual value it is to them, they will be willing to pay for it, but you must, at the beginning, make the cost very low to them, as it is with us.

Mr. Harwood. There's one point brought out by the lecturer which has been somewhat eclipsed by another, and that was in reference to selecting cows by points, or by their exter-

nal shape, by the eye and by the feeling. It seems to me in regard to testing, as far as the cow testing is concerned, that that will tell what a man has after he owns his herd. But sometimes he wants to go out and buy a herd. I should be disappointed if Professor Dean did not agree with me in this, that the handling of a cow, the viewing of the different points of a cow, are all the sum of experience, which you call judgment, and is an ability, and is of great value in the selection of cows.

Professor Dean. It is, if you were dependent upon a man's word as to what she'd give, regardless of your own experience; but you have this to back you up if you have your cow-testing association. Here's a certain cow that has been fairly tested; you have her official record, and you know what she has done.

Mr. Bursley. Some of us in getting a herd of cows would rather have those sleek, nice, straight-backed, wedge-shaped cows, with nice horns, even if they didn't give quite so much milk. I think I like to have those sleek ones myself. I like to buy the cow that the other fellow wants, too.

Question. Do you have score card tests?

Professor Dean. I do not use the score card at all. Not all the men in our college, however, would agree with me. I only teach the live stock part to our special short-course students. I think it is of some advantage in calling attention to the different points of a cow, but as far as telling the actual value of the cow goes it may be a guide to that man in his own experience when he goes out to buy cows, and has not an opportunity to test them. There's no doubt that the average man likes to have a nice-looking cow, but a cow that is a fine looker may not always be a good milker. A more important point, that is a great problem in itself, is the keeping account of the cows' feed, what their milk produces, what it brings in the market, what profit at the end of the year. These are the problems that are at the foundation of dairy economics; yet they must have our attention more or less.

The Chair. I think the trouble in forming cow-testing associations is the expense. When you ask a farmer to pay

a dollar or two dollars for every one of his cows a year, when he has all he can do to pay his taxes and other bills, it seems unreasonable. In order that these organizations may be successful, some means must be employed whereby the charge can be cut down to a nominal sum. I understand an association was started in Barre, but after the farmers found it was so expensive they all backed out. Perhaps Mr. Smith can tell us about this attempt.

Mr. John L. Smith (of Barre). This was in the town of Hardwick, not Barre. Over 100 cows were pledged; but for some reason or other the scheme was not carried through. All they planned to do was simply to weigh the milk.

Mr. John S. Anderson (of Shelburne). I would like to speak about like producing like. I am an old breeder, and have had quite an opportunity to judge between pure-bred cattle and grade stock. When you come to like producing like, I recall a few years ago one of my neighbors who had a wonderfully good grade cow; and from that cow he sold in a year, besides supplying a family of five with milk and butter, a little over 500 pounds of butter. He used to carry a 10-pound box of butter every week to Boston. That is the test for me; that is better than any Babcock test. Now, from that cow he never got a calf anything like the mother. I have in mind a pure-bred cow that we have on our farm. She gave 60 pounds of milk a day, and from that milk she made 3½ pounds of butter. That is no Babcock test; that's the test you can see, gentlemen. That cow's calves proved to be wonderfully good butter cows. We had another cow that, two weeks after she calved, made 20½ pounds of butter in a week on nothing but hay. None of her calves were like herself; but the pure-bred, mind your eye, that's where like produces like. The cow that's got the good blood in her will transmit it; the other is just as likely to produce the bad as the good.

Professor Brooks. You are aware that our president has appointed a commission on country life, and some farmers are quite wrathy over it, and suggest the appointment of a city life commission, and various suggestions of that nature. While I may agree with them that conditions elsewhere than

in the country need investigation, I am ready to admit that conditions on the farm may be improved. I was particularly interested, therefore, in what the lecturer had to say concerning the carriers, transportation, etc., in their bearing upon conditions in the open country; for I am convinced that these things have much to do with the results which we are getting on our farms. I do not believe we realize to what an extent we are taxed by the tariff. We do realize that there are trusts; tobacco men realize that there are trusts who have them at their mercy, and who will pay just what they please for their crops. And we know it is very easy for milk dealers in a city to come to an agreement and unite together, and say they will pay so much for milk. We know that agreements among farmers, who are so much more widely scattered, are far more difficult. So I think we ought, as farmers, to very carefully consider these questions. We need better express rates, we need better rates from railroads, we need parcels-post, and we need legislation, both State and national, which will make conditions less favorable to trusts. With these things accomplished, conditions in the open country will be better. I have great faith in the farmers; I believe that they, when they think and study these problems, can settle them for themselves. Give them a fair chance in the economic world, a fair chance to get a fair share of the prices which the consumer pays for their products, and the farmer will be all right.

The Chair. We would like to hear from Professor Gribben.

Prof. R. L. Gribben (of Amherst). I want to lay emphasis on one thing if I can in any way. I'll call it a hobby of mine and ride it. That is, the cow-testing association. I don't know what can be done; I am not well enough acquainted with conditions as they are, but it seems to me that one of the points brought out, that some cows are paying a profit while others were "paying a loss," is something that ought to be given considerable attention, especially when we consider that every dollar counts to the farmer as perhaps it does to no one else. As long as there are cows kept on the

farm that are causing a considerable outlay, with no return, there will always be more or less loss, and, at the same time, considerable fault finding at the conditions of country life. If we could get at some way to get rid of those cows, those animals that are causing a loss all the time, it would be one step towards improving conditions on the farm. I think this meeting will not have lost its purpose, and will have accomplished a great deal of good, if we can only start some organization which will have as its end a cow-testing association. Is it not worth one or two dollars a year for the farmer to know which cow is paying a profit and which a loss?

Mr. C. E. Ward (of Buckland). Speaking about these cow-testing associations, you have got to get the farmer first. Our western Massachusetts creameries are ready at any time to test a man's herd. If the farmers in the vicinity of Ashfield, for instance, care to know what their cows are doing, they have them tested, free of cost, and wherever there is a creamery I have no doubt that can be done.

If President Roosevelt's commission is going to do something for the country people, why, let us have it. Yet I believe that in rural Massachusetts the people of the country are more and more becoming awake to their privileges and opportunities; they are more and more enjoying life; they are more and more becoming what they should be, — part and parcel of this country, taking their places where they belong. They do not think they are lost in the country, but they think they are the people, and are going to be some one, and hold up their heads alongside of any of them.

Mr. Geo. B. Fiske (of Boston). Organization is what is needed. If each farmer here would go home and use the telephone and local papers to get speakers, and advertise a meeting to consider matters relating to country life, then send a report to the county commissioners, to their representatives in the State and national Legislatures and get things going, — then there would be some prospect of their getting what they want through their public representatives.

Professor Brooks. I want to emphasize what the last speaker has said. In Amherst we are trying to do just that.

Some of us work the telephones, talking with the farmers we can get, asking what they think about holding meetings, and we are going to have a country life meeting in Amherst. So far as I have heard, there is no farmer who does not say he will come and talk the thing up among the farmers he meets. If it does not do any other good such a meeting will get them to thinking about our problems, and when we begin to think out a problem in real earnest then some good will follow.

In the evening a banquet was held under the auspices of the Greenfield board of trade, at the Mansion House. Archibald D. Flower, secretary of the board of trade, was toastmaster. The distinguished guests were Lieutenant-Governor-elect L. A. Frothingham, Hon. Joseph Walker of Brookline and Prof. Rufus W. Stimson, director of Smith's Agricultural School, who delivered an address on "School and Farm."

Others who took part in the speaking were Hon. H. C. Parsons of Greenfield and Hon. Frank Gerrett and Mr. Chas. E. Ward of the Board of Agriculture.

THIRD DAY.

The session was called to order at 10.30 o'clock A.M., by Secretary Ellsworth, who introduced Mr. Frederick A. Russell of Methuen as the presiding officer.

The CHAIR. It gives me great pleasure to perform this duty at this meeting. The subject is one of the most important that can come before an agricultural body. I believe that we, as farmers, agriculturists, should be in a position to leave this world in a better state of cultivation, better state of fertility and better state financially, so that we have been a benefit, when we come to lay down our labors, to those who come after us.

It gives me great pleasure to introduce to you Dr. E. B. Voorhees, director of the New Jersey Agricultural Experiment Stations and president of the State Board of Agriculture.

THE PROFITABLE USE OF COMMERCIAL FERTILIZERS.

BY DR. E. B. VOORHEES, NEW BRUNSWICK, N. J.

I have chosen the subject "The Profitable Use of Commercial Fertilizers" in order that I might, as far as possible, eliminate any scientific discussion which might have a tendency to confuse or in any way to lead your thoughts away from the very practical question of the relation of fertilizers to improved crops and to profit, and also that I may talk to you as a farmer to farmers. Naturally, it is necessary that we know something definite concerning the principles involved, but in these days, and after twenty years of work of experiment stations, we must assume that the farmer knows what fertilizers are and something of their general usefulness.

For example, I must assume that all farmers know that the essential elements of fertility are nitrogen, phosphoric acid and potash; that lime is not classed with these constituents because most soils do not need lime as an actual additional constituent in the same sense, although it has many important functions and bears a relation to profitable fertilization which should not be ignored, and which we must, as far as possible, understand.

I assume, also, that farmers know that nitrogen is one of the most important elements of plant food, and that in many instances, particularly on lands that are not producing satisfactory crops, the deficient element is more often nitrogen than any other. Farmers also know that nitrogen is the most expensive element of plant food; it costs three times as much as phosphoric acid and potash in mixed fertilizers, and differs from the mineral elements in the sense that it is a very elusive and unstable element existing in various compounds,

organic and mineral, but always liable to changes which may cause its escape into the atmosphere or its loss through the drainage into the streams and rivers. It is, therefore, important that we should know its origin, its various transformations and its comparative usefulness as an element of manures.

We all know that nitrogen may be obtained for fertilizer purposes in two distinct classes of compounds: first, those which are soluble in water; and second, those which are insoluble. The soluble compounds of nitrogen are those which naturally become more quickly available to plants than do the insoluble. In fact, in the soluble forms we have nitrogen in the form of nitrates, of ammonia, and, in combination with other materials, as lime in the newer product, cyanamid and lime-nitrate. These, whether nitrate or ammonia, are readily soluble in water, and freely distribute themselves throughout the soil, and, with the exception of nitrate, form fixed compounds which are not liable to be lost by leaching in case of heavy rains, and which are not generally likely to be lost in the atmosphere, unless the soil is wet and compact, or is exceedingly rich in lime.

Of these three forms of nitrogen, nitrate is the most important, because it is the form in which plants take up the most of this element. In other words, it is the form to which all other forms must be converted before plants can take it up; the nitrate form is, therefore, quickly available to plants, being absorbed by them immediately it comes in contact with their roots, and is especially useful, therefore, as top-dressings for meadow lands, for grain crops, for hay crops, for market-garden crops and for all quick-growing crops, whose chief use is the edible portion of the leaf or stem.

Of the ammonia forms, we have as the chief source of supply sulphate of ammonia, which, because of its solubility, is almost as quickly available as the nitrate. It distributes readily in the soil, is fixed, and then quickly changes to a nitrate form, and is useful practically along the same lines as nitrate, except its continuous application in large quantities has a tendency to cause acidity of soils. In wet seasons

it is likely to be, under average methods of application, quite as useful as the nitrate, if not more so. In dry seasons, the nitrate, being in the most useful form when applied, is likely to be more serviceable than the ammonia.

In reference to cyanamid, lime-nitrate, and the other new compounds which have recently been placed upon the market and whose position as yet has not been fully determined by experimental work, will probably be classed with the ammonia. The very fact that these exist in soluble forms suggests a greater usefulness for them than for the inorganic forms derived from ordinary supplies.

Farmers also know that the chief sources of supply of insoluble nitrogen are derived from what are called organic forms, — forms which must decay before the nitrogen contained in them can distribute itself and feed the plant. Furthermore, because it is necessary that decay shall take place before the nitrogen becomes available, the rate of availability will depend very largely upon the rapidity with which the substance is likely to decay. Substances that are soft, easily penetrated by water and air and easily made fine by grinding, or other processes, are more likely to give up their nitrogen to plants than those which are hard and dense, and which resist the attacks of soil solvents or other processes of decay. Nevertheless, because of the characteristics which they possess, they play an important part in the uses that may be made of commercial fertilizers containing nitrogen. Of these substances, those that are the most quickly available are dried blood, dried meat, cotton-seed meal, linseed meal, castor pomace, meat tankage and ground fish, and those which are likely to decay slowly are ground bone, ground tankage, ground leather and products of a similar character. It is obvious, therefore, that aside from the relative availability of the nitrogen contained in the two groups of nitrogenous substances there is another advantage derived from a knowledge of the sources of supply. For example, in the case of nitrate of soda or sulphate of ammonia we have products which are uniform, both in their composition and in their rate of availability, under similar conditions. In other

words, a pound of nitrogen from nitrate of soda or a pound of nitrogen from sulphate of ammonia has a value which does not depend upon the original source of supply, — one pound of nitrate is just as good as another from whatever source derived. The same is true in the case of ammonia; if it is actually ammonia, one pound is as good as another, and this will probably prove true in the case of the new products, not yet fully investigated.

In the case of organic products, on the other hand, the value of a pound of nitrogen will vary widely, depending upon its source of supply; the farmer in buying a commercial fertilizer, in which nitrogen exists both in soluble and insoluble forms, can absolutely depend upon the nitrogen in the soluble form, but, unless some special tests are made, cannot depend upon the forms of the organic nitrogen, as they will vary widely in their rate of availability, the rate ranging, say in dried blood and leather, from 75 or 80 per cent in dried blood to practically nothing in some forms of leather, when compared with the standard or nitrate form. The farmer, therefore, in purchasing his supplies should know not only how much nitrogen is contained in the brand, but in what form it exists, and then purchase that brand which contains the forms in such kinds and proportions as, in his judgment, will best meet the requirements of his crop.

The same considerations in a general way apply to the phosphates. All farmers know that animal bone is a good source of supply of phosphoric acid. They also know that the availability of the phosphoric acid will differ in different samples. They are also familiar with the fact that other sources of supply of phosphoric acid in their original and untreated forms will vary widely in their rate of availability, and, therefore, in the usefulness of the materials for different purposes for which they are used. They also know that ground bone is likely to give up its phosphoric acid to plants much more quickly than the ground phosphate rocks of Florida, South Carolina and Tennessee, even when ground to the same degree of fineness. They understand, moreover, that ground bone is an organic substance, and, even in its

original condition, or when coarsely ground, is likely to decay. Farmers from the earliest times have used animal bone, — we have references in both ancient and mediæval history to the use of bone for certain crops, and our economical ancestors in this country also made a practice of saving and using the bones which accumulated in the household, placing them about the roots of fruit trees, of grape vines, currant bushes, etc., knowing that they would supply the needed sustenance, but not knowing the reasons why.

In more modern times, because of this knowledge, inherited and acquired by experience, many farmers prefer to use the phosphates derived from bone rather than those derived from phosphate rock, even if in the latter the availability may be very largely increased. This general experience, and this prejudice in favor of bone, has its foundation in science; or, in other words, scientific investigation of this substance has revealed the reasons, in part at least, for such belief. Perhaps the best statement that can be used to express the reason differences in result are secured from these two classes of phosphate, or ground bone and rock superphosphates, is "that ground bone is never poorer than the day it is applied, — its tendency is to decay and thus become more available as time goes on, whereas, in the case of superphosphates, it is never better than the day it is applied," for the tendency is to revert to the naturally insoluble condition. In the case of the bone the effect is lasting; in the superphosphate it is immediate.

The supply of organic phosphates is, however, inadequate to meet the demands, and the ground mineral phosphates and superphosphates are now more largely used, and they have a very important place in the economical and profitable use of commercial manures; moreover, the superphosphates made either from ground bone or ground phosphate rock, possesses an advantage for quick-growing crops that cannot be met by the phosphatic materials in their original condition. In the process of manufacture the insoluble compounds are broken up and made soluble, the phosphate not only becoming more available, but more easily distributed in the soil,

coming in contact everywhere in the soil with the small rootlets, making it possible to derive a larger proportionate return from the use of a small quantity of fertilizer or than is possible to derive from the use of original materials in larger quantities. Farmers should not and seldom nowadays do make the mistake of classing all phosphates in one group. The different products possess different characteristics, different chemical qualities, and all have their place in the upbuilding of the farm.

The recent attempts to encourage the larger use of ground phosphates in place of the bone or of superphosphates is, I am afraid, leading many farmers astray, not because the investigations that have been conducted are not to be depended upon; not because there is not a wide field for the usefulness of such products, but because of the natural tendency of many farmers to be guided in their purchase by price per ton, rather than by the kind and character of the material contained in the ton. When phosphate rock, containing 26 per cent to 28 per cent phosphoric acid, is offered at $8 to $10 per ton, delivered, and acid phosphate, containing 14 per cent "available" phosphoric acid, at $14 to $16 per ton, and ground bone, containing 22 per cent phosphoric acid and 3½ per cent nitrogen, at $30 to $35 per ton, the farmer who is not well grounded in his knowledge of phosphates and their effect is likely to take "a flyer," at any rate on the ground phosphate rock, and the chances are that this kind of a farmer will nine times out of ten never see any effect from the use of his phosphate rock. It has its place, but it cannot be compared with the other two forms or kinds, because it is not comparable with them in any strict sense, except in the total amount of phosphoric acid carried. The value of a phosphate lies both in its content of phosphoric acid and in the rate at which it will become available.

Superphosphates and ground bone are suitable for most crops, and returns will be obtained on most soils and on most crops the first year. Ground phosphates are suitable for particular kinds of soil and for particular and special treatment of soils. It is suitable more as an amendment, a

soil builder, than as a direct fertilizer in special kinds of farming. On soils rich in vegetable matter (humus), where decay proceeds rapidly and organic acids are formed, the ground phosphate rock will give in many cases satisfactory returns if applied in sufficient quantities. Ground phosphate rocks are also suitable for sour soils, which sourness is not due to excess of water. Ground phosphate rocks are not suitable for soils that have been farmed for a long time, and in which the vegetable matter is exhausted. They answer just about as well for this purpose as ground cobblestones. They are not to be depended upon for quick-growing crops, as those planted in spring and harvested within two or three months.

Another source of supply of phosphoric acid, which is very largely used in foreign countries and with great satisfaction, is basic slag, or Thomas phosphate powder, derived in the manufacture of steel from pig iron. This phosphate possesses several characteristics which are not possessed by any of the phosphates already discussed, and should not be confused with them.

In the first place, it is an alkaline product, carrying 40 per cent to 50 per cent of lime; and in the second place, the phosphoric acid is combined with lime to form what is called "tetra-basic" phosphate, or four parts of lime combined with one part of phosphoric acid; thus the phosphates are more loosely combined than in the case of the untreated phosphates from other sources, and when ground to the same degree of fineness are likely to be much more available. Theoretically, one molecule of the tetra-basic phosphate breaks up into two molecules of di-basic phosphate, making the phosphate correspond to what is known as "reverted" phosphoric acid in superphosphates.

For many purposes, therefore, this material is superior even to superphosphates, because carrying no free acids, and because the lime associated with it has a tendency to neutralize acidity in soils. Thus far this product has not been largely used in this country, and this is probably due to two reasons: first, its cost makes the phosphoric acid more expensive, as a rule, than in superphosphates; and second, the

material is such as to make it much less desirable for mixtures, although it can be mixed readily with potash salts and nitrate of soda. It is also very heavy, and not so easily distributed as the other phosphates.

Where it can be obtained at reasonable prices, its use is strongly recommended, being far superior to the ground phosphate rock, either of the nodular or apatite form. It is especially useful for acid soils, for soils rich in vegetable matter and for sandy and clay soils deficient in lime. Its value from the standpoint of availability, of course, is measured to a large extent by its fineness of division.

Plants must have and all soils must be provided with a suitable proportion of food, soluble, available, digestible, if the crops are to acquire enough food to make profitable crops. One advantage possessed by those insoluble materials, in the opinion of some, is that they prevent the soil from being exhausted; this is true, but there are many soils which have enough phosphates in them to grow maximum crops for a hundred years which will not grow a decent crop if not properly managed, and the further addition of substances of this sort will not cause " two blades to grow where one grew before."

It does seem, therefore, that, with this knowledge of phosphates, the farmer should be able to utilize the various materials at his command in such a way as to derive the greatest benefit in yield or crop, as well as in returns per unit of cost. That is, not only to be paid for the material and its application, but to give such an increase in crop as will give him a profit, while at the same time to have left in his soil at the end of a year more of the mineral elements that he had when he started. This is the crucial test of a good farmer, — one who not only grows large but profitable crops, — and after he has grown them his soil is left in better condition than when he started.

Farmers also know that another element of great importance on many soils is potash; and farmers from the earliest times have recognized the value of wood ashes, whose chief usefulness depends upon the potash that they contain.

This is also an evidence that plants in their growth remove from the soil a considerable portion of this compound. Potash, however, differs from the other constituents mentioned in that the form in which it exists does not measure its rate of availability, as is the case of nitrogen and phosphoric acid, but has a greater bearing upon the effect upon the soil and the quality of the produce. That is, potash exists in practically two forms — chlorides and sulphates. Muriate of potash is a chloride; kainit contains a mixture of sulphate combined with potash and chlorides containing magnesia and soda, thus making it in its effect upon soils quite similar in character to the muriates. The sulphate, however, though not quite as soluble, does not possess any qualities which render its application to crops superior to the other forms, so far as availability is concerned. It does, however, possess qualities which make it superior to muriate upon quality, for crops like potatoes, tobacco, sugar beets and small fruits muriates should be eliminated as far as possible because of their influence upon the quality of the product. The benefits of potash free from muriates has been clearly shown by the experiments conducted in your own State and Connecticut.

These facts, briefly stated, are the basis of our knowledge concerning fertilizer materials, and measure what we understand to be agricultural value. It does not follow that that form of nitrogen, phosphoric acid or potash which is the best is the cheapest in the market; nor does it follow that the cheapest is the best, — commercial values have absolutely no bearing upon agricultural value. The agricultural value of a fertilizer constituent is measured by the increase in crop that may be derived from its use under well-known conditions. Commercial value is based upon the business relations that surround the product, — the sources of supply, cost of transportation, cost of manufacture, cost of delivery, — all of these factors come in to fix the commercial value. Many products of the higher value agriculturally are the cheapest commercially and *vice versa*. Some of the poorest products in the market, agriculturally, are selling at high

prices commercially. It is the farmer's business to determine this relationship.

All of the facts here related are, or should be, well known, and are repeated mainly to refresh your minds, and get your thoughts in the right channel, for I am sure you have already questioned the necessity of such repetition of well-known principles; yet if we are to use commercial fertilizers profitably, they are but a few of the facts that should be known.

In addition to the importance of a knowledge of the sources of supply and their relationships, we must take into consideration, first, the soil itself. Soils vary widely in their chemical composition; they differ in their absorptive and retentive qualities; they vary widely in their location, — all of which conditions have a very important bearing upon the commercial or profitable use of these materials. If we roughly classify soils we find them grouped about as follows: sandy soils, loamy soils, clay soils and peaty soils, — each group possesses characteristics which should be a guide as to the kind of fertilizer to use and method of using it.

It can be safely assumed that most of the soils in New England have been derived from a mixture of various rock particles, which are distributed in the valleys in a more or less fine condition, and these, even on the hillsides that are capable of being worked, are naturally rich in all of the fertility elements, and when good crops cannot be secured without the application of commercial fertilizers, it is not because they are naturally poor, but because of their past management and cropping; the available constituents have been depleted to such an extent as to prevent the plant from getting its normal supplies. The application of fertilizers, therefore, becomes a necessity, more especially in the absence of yard manures, or where quick-growing crops are desired. That is, the natural methods for the improvement of these soils cannot be accomplished so quickly, nor so successfully, nor so profitably without as with the use of commercial fertilizers.

There are many soils, too, in this section of the country that

are naturally poor, and need building up in all directions; they are deficient in the mineral elements; they lack vegetable matter, humus and nitrogen, and are poor in physical character; they need to be supplied with a sufficient total quantity of plant food, as well as with such amendments as will enable improving crops to be grown. It is quite evident that, for such conditions, in the selection of fertilizers for the growing of crops of any kind, the kind of soil or its original character should be a very safe guide as to the supplies. In extensive general farming, in grain farming, or in extensive practice of any kind, we should be guided by the character of the soil, but only up to a certain point. It may be safely assumed that light sandy soils are all deficient in mineral elements. That is, the total supply is not sufficient, and in order that these soils may be made fruitful, an abundance of all materials is needed. For those naturally rich in fertility, as the clay loams of various degrees, we need more particularly phosphates and nitrogenous materials. Peaty soils, very rich in vegetable matter, are chiefly deficient in the minerals, including lime, and any treatment or fertilization which did not take this fact into consideration would probably not be a profitable method.

Furthermore, soils that have been depleted in their vegetable matter, or soils that are naturally poor, ordinarily do not possess a good physical character. They are too hard or too dry, too wet or too compact, or too loose, and fertilizers applied do not have their full effect, because, in the first place, they are not readily distributed throughout the soil, or are distributed too rapidly; or, in the second place, there is danger of loss, more particularly of the nitrogen applied, — the most expensive element. Therefore, to ensure the best returns from the application of commercial fertilizers the soils must first be improved by natural methods.

Farmers, therefore, who buy expensive fertilizer materials for the growth of cheap crops will not find it profitable to do so on soils of this character. It is not only a question of a fertilizer, but a question of a desirable place to put it, that measures in large degree the usefulness of its application. These points are of the greatest importance if we are to use

economically and with profit the very useful materials that are now upon the market in concentrated forms. Soils poor in respect to total plant food and physical character very frequently need lime, and an abundance of it, even if the soils are derived from the decomposition of limestone. Clay soils that are dense and compact need lime in order to flocculate the fine particles, making them more open and porous, and the loose sandy soils need lime, both to provide the plants with this element, as well as to make them more absorptive and retentive of water and plant food. They should also be supplied more generously with vegetable matter which has a tendency to decay, and which encourages those activities, bacteriological, chemical and physical, which permit not only the easy and more ready distribution of the fertilizer elements, but their rapid change into available forms.

Another matter of very great importance in a way (yet I am satisfied too much importance has been given to one phase of the question and not enough to another) is the fact that different plants require different kinds and forms of plant food. This has given rise to the manufacture of different brands of fertilizers suitable for different crops. That is, plants have been classified into groups, — nitrogen-loving, or those that require a relatively greater abundance of nitrogen; the phosphatic groups, which do not make rapid growth and mature properly without an abundance of phosphoric acid; and the potash-consuming plants which luxuriate in an abundance of this mineral. That is, a crop belonging to the first class must have nitrogen in excess of the other elements; plants belonging to the phosphatic group must have phosphoric acid in excess; and the same is true of the potash group. The difficulty with this reasoning is that plants whose composition shows an abundance of any one of these elements are not an evidence that a larger supply of available food is required, but that because of their habits, their root systems and their time of growth, certain plants are able to acquire a larger proportion than others to use in their construction and development.

On the average, it is not so much a question of proportion

of plant-food elements as it is a question of amount applied. First, see to it that an abundance more particularly of the minerals are furnished, and the proportions will take care of themselves. This, of course, is only true in a general way. Formulas are good, but theoretically it is not a question of formula but a question of giving a plant that which it needs at the time it needs it. We are surely wasteful in the use of commercial fertilizers, first, because we use them unsystematically, without definite relation to character of crops, rotations, seasons, soils or object of growth; and in the second place, we are using them foolishly, because we don't know what we are using or why we are using it, and thus often get absolutely no return.

The previous treatment of soils, so far as cropping and fertilization are concerned, also has a bearing upon the matter of present fertilization. It is a well-known fact that continuous cropping will result in the greater depletion of not only one or more elements of plant food, but that, unless accompanied by cover crops and green manures, will result in a very rapid removal or loss of organic matter, thus causing the condition of soil to be less favorable for the absorption and distribution of fertilizers than would be the case if "condition" was maintained. In the east, this method is not generally used; nevertheless, the practice often followed results in practically the same thing. In many instances, grain crops, like corn, oats and wheat, are grown exclusively for sale. That is, the grain is sold in all cases, and only enough stock kept to carry on the work of the farm, thus making the returns to the soil consist chiefly of the straw and stalks which accompany the grain.

This kind of farming results in a very rapid removal of the phosphates, more particularly as the grain contains a larger proportion of these, while the potash and nitrogen would be returned in greater amounts. Hence, cropping of this sort would require different fertilizers than if the purpose of the farming had been to utilize all of the products raised upon the farm. In farm practice of this kind, therefore, if it is to be profitably continued, there will be a relatively greater demand for phosphates and nitrogen than for

potash, and because the natural means of improvement are apt to be neglected, it will be necessary, in order to meet the immediate requirements, to apply the kinds which act quickly and distribute readily, as the active agents in the soil would not assist to so great an extent in making plant food available. When a scheme of fertilization is adopted in extensive systems, which takes into consideration these various factors, it is possible not only to encourage and provide for a larger growth, but to enable the plant itself to accumulate from soil sources a much larger supply of the needed elements than would otherwise be the case.

In the use of fertilizers for general farming, or for extensive systems of practice, two points must be carefully observed: —

First, it must be remembered that the crops included in such systems are, as a rule, those which belong to the class that may be regarded as low in commercial value and high in fertility value; they are exhaustive crops, removing a large proportion of fertility per unit of value. That is, in the selling of wheat, corn, oats, rye, buckwheat, etc., a larger proportionate amount of fertility is sold, and at a lower price, than in such crops as potatoes, market-garden crops and fruit. The fertilizing, therefore, should be of such a character as to supply the general needs of the crop, while at the same time providing residues which shall accumulate in such a way as to result in the improvement of the soil in these respects.

Second, in general farming, as a rule, the condition of the soil is not such as to enable a large application of fertilizers to be as proportionately helpful as in the case of soils more intensively cultivated, and thus in better physical and chemical condition. In the use of fertilizers for these crops, therefore, the aim should be to decrease the initial expense for fertilizers, while at the same time providing for a maximum supply of minerals. This would seem to be difficult, as analyses of the crops thus grown, as, for example, corn, oats, wheat, rye, barley and hay, show that the proportion of nitrogen contained in them is much greater than is either of the minerals, phosphoric acid and potash; besides, nitrogen is

the most expensive element to supply, costing, on the average, four to five times as much per pound as the minerals.

As a rule, too, soils that have been worked for a long time show a greater deficiency in nitrogen than in the minerals, — probably due in part to the greater liability to loss of nitrogen. In fact, all data we have point to the necessity of a liberal use of nitrogen if we are to obtain maximum yields, and its rational use if we are to obtain paying crops of this character.

For these crops, therefore, we must adopt a method which will encourage the largest use of soil supplies, as well as to furnish the nitrogen in such amounts and forms as will be utilized to the fullest extent, and applied at the time when the plant is in the greatest need and absorbs it most completely.

The profitable use of fertilizers for these crops depends largely upon this point, viz., the utilization of the element, nitrogen, both in the soil and in the materials applied. The use of the soil nitrogen will, furthermore, depend upon the use of minerals, for the liberal use of minerals will stimulate and encourage the plant to draw more heavily upon the soil supply of this element. Following these suggestions, and keeping in mind the fact that we are growing crops of a high fertility value, a general formula which will furnish a maximum supply of mineral constituents which are liable to be useful for all crops in the rotation is used. We have found that a formula made up of ground bone, 100 pounds, acid phosphate, 100 pounds, muriate of potash, 50 pounds, per acre will furnish enough of the mineral constituents, especially, to provide for such an increase in crop as will more than pay for the fertilizers used and the expense involved, and leave a residue available for other crops, as the kind of materials used are such as to provide against such changes as will result in fixed or insoluble compounds, — the phosphoric acid being partly drawn from organic sources, and thus gradually converted to available forms.

The cost of this formula, if the materials are purchased in their original form, would not be heavy (not to exceed $4 per acre), and could be applied to each crop in the rota-

tion. The farmer can also fortify this application in special cases by the use of quickly available nitrogen at the time of its greatest need.

For example, the wheat and grass crops more than any other general crops respond favorably and profitably to top-dressings of nitrate of soda in spring. Hence, with an abundance of minerals to stimulate the early growth of the plant, a top-dressing of nitrate may be made to these crops, with a reasonable assurance that only normal development will take place.

Dr. Paul Wagner, the eminent European experimenter, strongly advises this method, and maintains that with the conditions properly understood the farmer is able to diagnose his field and to be able to apply the nitrate so as to guarantee the yield that will be obtained from a given amount of nitrate. That is, his experiments have shown that practically 400 pounds of grain will be obtained from every 100 pounds of nitrate thus applied. The conditions are: (1) that the soil shall be abundantly supplied with minerals and shall be in good condition; (2) that the average yield obtained under present treatment shall be known; (3) the yield possible, or that fixed by the climate, season and variety.

For example, if the average yield of wheat is 15 bushels per acre, and the possible yield 28 bushels, 200 pounds of nitrate of soda will provide for and secure the increase, and so on for the different grain crops. His experiments also enable him to suggest suitable amounts for other crops. It is quite possible that these figures should be modified for conditions here, owing to the differences in climate, season of growth, rainfall, etc., although there is no doubt of the soundness of the theory and its practicability for our conditions. At any rate, this method provides for an economical use of the fertilizer constituents, the constant building up of the soil and the easy and gradual development of the "intensive" from the "extensive" system, while at the same time harvesting profitable crops.

In special lines of farming as, for example, the continuous growing of grass, much more depends upon the preparation

of the soil, seeding and fertilizing than in general farming, because we are providing for a continuous cropping, without the ability to introduce and thoroughly distribute throughout the soil the various kinds of plant food. Therefore, in the preparation of land for hay great care should be exercised in getting the soil in good condition, and thoroughly distributing in it a liberal supply of fertilizer constituents, more particularly the minerals, sufficient to supply the plants for a number of years. The same formula mentioned above may be used, but applied in larger quantity, — preferably from 600 to 800 pounds per acre at time of seeding down; this quantity not only providing an abundance of food for the germination and early growth, but a permanent supply for future and profitable crops, provided a sufficiency of nitrogen of the right kind is applied at the right time later. This can be accomplished by the judicious use in the spring of soluble nitrogen in the form of nitrates, ranging for the varying conditions of soil from 150 to 300 pounds per acre, — the smaller quantity being used upon the poorer soils. Many are of the opinion that nitrates so used cause a too rapid exhaustion of the soil; this is an erroneous opinion, provided there is such a balance of food as to provide for normal growth. This system is now used by many of our farmers, and the fields maintained, though large and profitable crops are annually harvested. Frequently, however, the nitrates for top-dressings are mixed with bone, tankage, acid phosphate and potash, both to enable an even distribution and to provide additional minerals for longer periods of cropping.

By the larger use of the minerals, which are not liable to be lost nor to be changed into fixed and unavailable forms, and which are at the disposal of the plant, the danger of loss of nitrogen is avoided because of the entire occupation of the soil by the vigorous growing of the plants; the nitrogen is applied in forms taken up at once. Maximum crops may be harvested year after year, and the land not reduced in available fertility as rapidly as would be the case if not thus well supplied with plant-food. Many failures in grass growing are the result of injudicious fertilization in this respect.

In the case of market-garden crops, which belong to the

class possessing high market value and low fertility value, the conditions are very different. Here the profits will depend not only upon total yield, but upon the quality of the crop, which is measured in so marked a degree by rapidity of growth. It is not a question of supplying the needs of the plants only, but rather of furnishing them with such an abundance or such an excess of plant food as to absolutely guarantee them under any reasonable conditions against a shortage in this respect. That is, we cannot be guided by the possible removal of constituents by the crop itself as to the amount that shall be supplied. It is required that we shall not only take into account the characteristics of the crops themselves, — that is, the time of growth, the object of the growth, etc., — but the possibilities of periods during these times of growth when they shall require to have at their disposal an excessive amount of available food, in order to enable them to make up any losses in growth that may have occurred because of unfavorable conditions.

We have many examples of the importance of this point in the use of commercial fertilizers for this class of money crops, as asparagus, early potatoes, cabbage, celery, early beets, turnips, as well as the successful application of the principle in general crops of this class; the value of the crop in many instances being enhanced 50 or 100 per cent, or even more, because of the extra addition of 500 pounds of commercial fertilizer per acre. The best asparagus grower in our State, and, so far as I know, as good as in any State, whose returns are marvelous, informs me that every pound of fertilizer added to his soil in excess of 1,500 pounds per acre and up to 3,000 pounds, pays him an enormous rate on the investment, — he secures not only the highest yield, but the very best quality, both in respect to size and edible quality. His crop is in a sort insured against unfavorable conditions.

As to the special fertilizers required much has been written, but in our experience the same principle holds true as in the case of the field crops, namely, that a general market-garden fertilizer, made up of the most concentrated and most available forms, shall be applied, and then fortify the specific

crop with that element which its characteristics of season or time, or object of growth, show it to demand.

As already pointed out, it is not so much a question of quantity and quality of the materials supplied. Formulas varying in respect to the elements may be, of course, varied to suit specific conditions, when conditions are known, but for general conditions a formula carrying 5 per cent nitrogen, 5.5 per cent "available" phosphoric acid and 7.5 per cent potash is typical. This may be made up as follows, nitrate of soda, 100 pounds, sulphate of ammonia, 100 pounds, dried blood, 150 pounds, ground bone, 100 pounds, acid phosphate, 400 pounds, and muriate or sulphate of potash, 150 pounds, and could be regarded as one of the best for crops of this sort, because it contains large amounts of nitrogen derived from the best sources of supply, enough organic substance to make a good mechanical mixture, and phosphoric acid and potash from best sources. For such crops as beets, cabbage, turnips and onions, large quantities of nitrate may be used in addition, ranging from 200 to 600 pounds per acre, preferably applied in fractional dressings.

One of the most prominent potato growers in New Jersey informed me that a formula given to him fifteen years ago, when he first began growing potatoes, carrying 4 per cent nitrogen, 8 per cent "available" phosphoric acid and 10 per cent potash, derived from best sources, and which he had applied at the rate of 1,500 pounds or more per acre, had been more useful, more profitable and more generally satisfactory than any other that he had used, in order to reduce to some extent the cost of the materials. He had come back to this formula, and the only variation that he has made in all these years has been in the amounts applied, — increasing it gradually from year to year. His farm is now regarded as one of the best for all crops, and his returns have been such as to enable him to live in the city part of the year, at summer watering-places a part of the year, and to spend his winters in Florida, all because he knew what commercial fertilizer to use for potatoes. His land was originally no better than thousands of others; his methods were no better; his business qualifications probably no better, but

he had made a success of farming because he acted on this principle.

Mr. B. W. Potter (of Worcester). Is there any difference between basic slag and slag meal? I notice when I buy slag that sometimes the bill is made out for slag meal.

Dr. Voorhees. No difference.

Mr. Crafts (of Whately). I use considerable ground bone, and I would like to know how long it takes to secure from that bone the phosphoric acid which is likely to come from it.

Dr. Voorhees. It depends upon how fine the bone is. I think that with bone of the average fineness, from one-third to one-half would be available the first year. The balance might be used up in two or three years. The coarser it is the longer it will last, but you do not get so large an immediate result.

Mr. Crafts. If we should continue the application of bone year by year, would there be danger of getting too great a supply of phosphoric acid?

Dr. Voorhees. I don't think so, provided you supply the other elements, so as to make a balanced food for your crop. Large supplies of phosphoric acid from bone would probably not work injurious results, but such applications would not be so economical.

Question. The tendency of phosphoric acid, as derived from bone or other sources, is to produce a luxuriant growth of foliage, is it not?

Dr. Voorhees. Not more so than in the case of any other constituent. It is believed by some that nitrogen causes too large a growth of plant and leaf, and does not contribute to the formation of the grain to such an extent as phosphorus. In one way that may be so, but it is not really so; it is only that that appears to be the effect when we have not got a balanced ration for that plant to live on. It is said that phosphorus encourages ripening. It does not encourage the ripening any more than nitrogen or potash, unless there is a deficiency in some of the other things.

Question. You don't think an excess of phosphoric acid would make the plant ripen slower?

Dr. Voorhees. You can put on a whole lot of phosphoric acid, and leave out the other elements, and the plant will appear to ripen quicker.

Mr. Crafts. I am a tobacco grower, and that, in this valley, is one of the important industries. In growing a crop of tobacco we want quality, but it is desirable to have the tobacco ripen in reasonable time; we must get it ripened and ready to harvest before frost, and early enough so it will mature properly. It was a question in my mind whether a surplus of phosphoric acid which we derive from bone and other sources would tend to keep that plant growing vigorously until too late in the season.

Dr. Voorhees. I don't think so. I can see very easily how we might change the character of the growth by adding an excess of one, or displacing one, when we wanted to get an abnormal growth. But I do not think you would get it by that means. It would make it ripen quicker because of the lack of the other food. When it ripens too soon it is because the conditions are not favorable for it to obtain all the food. Now, phosphoric acid in excess does encourage that, but it won't do so unless it hasn't enough of the other materials present. I know very little about tobacco growing from the practical side. But it does not seem to me it would do it in that way. But you might get an abnormal growth there, which might be of more value to you than a normal growth. In our market-garden crops we don't get normal growths. That is, the natural tendency is to grow to maturity; but we don't want maturity. We apply an abundance of nitrogen, an excess of nitrogen, and we get an abnormal growth.

Question. You think an excess of nitrogen would cause longer growth, more luxuriant growth, than the phosphoric acid?

Dr. Voorhees. Certainly.

Question. And you don't think phosphoric acid would contribute to that?

Dr. Voorhees. No, not in the same way.

Mr. W. H. Bowker (of Boston). Dr. Voorhees, have you read the last "Science Monthly," in which Dr. Hall speaks of soluble phosphoric acid as hastening maturity? Do not

Lawes and Gilbert's experiments indicate that soluble phosphoric acid serves two purposes, — one to supply the needed phosphoric acid for plant growth, and the other to assist in the assimilation of other plant food ingredients? Now, in your opinion, does phosphoric acid in this form tend to hasten maturity because it helps the assimilation of other plant food elements?

Dr. Voorhees. That's very true, but that would be normal ripening, however. It would not be abnormal ripening, and it would not hasten it in the sense that it would not ripen before it ought to ripen.

Mr. Bowker. Does not soluble and reverted phosphoric acid have a catalytic action in the soil? In other words, is it not a fertilizer and a "catalyzer" as well? I think it is very important to have soluble phosphoric acid, and plenty of it, in a tobacco fertilizer, not only to supply the required phosphoric acid, but to hasten maturity. We know that in growing Indian field corn an excess of available phosphoric acid is essential. Experience has shown this, although science may not have shown the reason why. Science should and usually does lead, but in some cases it has not caught up with the procession. Liebig, the father of commercial fertilizers, discovered, as you know, that superphosphate of lime was much better than undissolved phosphates or undissolved bone. The great chemical fertilizer industry was founded upon dissolved bone, carrying about 2 per cent of nitrogen and 12 per cent of soluble phosphoric acid, no potash. This fertilizer was used chiefly in New England in the hill for corn, and to this day farmers buy it with a little potash added to push and hasten maturity. I believe science will prove, if it has not already done so, what experience has discovered, — that soluble and reverted phosphoric acid serves two offices in the soil, that of food supply and that of assisting in assimilation.

Dr. Voorhees. The application of phosphoric acid simply made the conditions more nearly normal for the development of the corn plant. The plaut needed more phosphoric acid to enable a normal growth.

Mr. Bowker. Then what did Dr. Hall mean in his article?

Dr. Voorhees. There is no question but that each one of the constituents has its own peculiar function, and the presence of a normal supply of phosphoric acid simply encourages that plant to make a normal development. In many instances we don't want abnormal development. A man grows potatoes, and he gets vines and not a proportionate yield of potatoes, although his land is good and capable of fully 150 barrels to the acre. He gets vines because he has put in organic matter containing nitrogen and has not a sufficient abundance of available minerals. The plant will take up the nitrogen, but it hasn't enough of the mineral to balance the ration.

Mr. Bowker. The potato growers of Aroostook County are experts. To insure the abnormal growth of tubers, not potato balls, say, 300 bushels to the acre, they apply an excess of plant food, and especially an excess of available phosphoric acid. Aroostook County is as far north almost as Quebec, but in my judgment it could not produce the enormous potato crop it does if it did not use from 1,200 to 1,500 pounds of a well-balanced fertilizer per acre, which is no doubt an excess, and also if that fertilizer did not contain as much of soluble and available phosphoric acid as it contains of potash, and twice as much as it does of nitrogen. The commercial farmer should not stint a growing crop any more than he would stint a lusty, growing calf.

I was glad to hear Dr. Voorhees emphasize the importance of changing from general farming to specialized farming. Here in Massachusetts we cannot afford to raise small grains or grass except in the course of a rotation. We should practice intensive agriculture, and grow the finer crops, such as onions, lettuce, celery, tobacco, ensilage, fruits and flowers, which as a rule are not only abnormal crops, but usually more profitable crops.

I was also glad to hear him advise the use of more fertilizer or plant food than is apparently needed. To produce abnormal growth this is necessary. The late Joseph

Harris, speaking of abnormal growth, said the cabbage left to itself would run to a seed stock, but we had converted it into an abnormal head. The tobacco plant, left to itself, would run to seed, but we top it and produce an abnormal leaf. As we have changed the nature of many of our agricultural plants from the normal to the abnormal, we must, therefore, change our mode of feeding.

To digress a little, I think we should utilize all our by-products, and, to that end, that the agricultural chemists and sanitary engineers should get together. We have been talking about the use of nitrates, phosphates and chemicals generally, but if it were not for the chemical fertilizer manufacturers, who are searching the world over for plant food and converting it into available forms, the cost of plant food would be much higher than it is. I hope that this Board and our experiment stations will consider the great economic problem of supply and demand which underlies the question of keeping up the fertility of our soils. Within a short time a commission of sanitary engineers has recommended to the mayor of Boston that the city burn up its garbage. City garbage, composed as it is of the swill which comes from the houses, contains more or less fertility. To burn it up when it might be converted into available plant food is, in my judgment, not a sound, economic policy. What Boston does is likely to be copied throughout New England, and our house garbage, and many other by-products, will be converted into gas and smoke in the interests of sanitation and health, although a distinct loss to agriculture. The agricultural chemists and the sanitary engineers could not do a better work than to get together and agree upon some plan which shall utilize all plant food products, and, at the same time, be sanitary.

Prof. Wm. P. Brooks (of Amherst). I have seen many things in my experimental work which have convinced me that if phosphoric acid is in relative excess, — although there may be enough there, enough potash there for a real crop, — still the crop will mature earlier, go forward faster from the very start. I have seen many results which convince me that potash has a great deal to do with the development

of stem and leaf. I have found in a number of experiments, not only in Amherst but also over the State, that abundant potash means a better ear of ensilage corn; potash increases not only the grain and the stalk, but it increases the stalk and leaf relatively more than it increases the corn. I would emphasize, I believe, adapting the fertilizer to the crop a little more strongly than Dr. Voorhees has done; for experimental work of the past twenty years has impressed upon my mind more and more strongly the fact that, in the case of each of our important products, there seems to be one of the three important elements which will increase that crop to a much greater extent than the others. So that I am inclined somewhat to emphasize in my advice to farmers, most of whom are using manure as well as fertilizers, keep in mind the dominant element for your crop, and make sure that the fertilizer which you use in general farming in conjunction with manures shall be strong in the dominant element for the particular crop which you want to grow.

Question. How about using phosphate rock in connection with manure?

Dr. Voorhees. I should use these insoluble phosphates on soils rich in vegetable matter, or with manures, to get results on soils not naturally rich. You apply them on soils where there is little activity and the chances are the acids will not attack them very strongly. Apply them on manures, and the natural tendency of manure is to decay; and as the decay proceeds, acids are formed and the insoluble compounds are made available. Experiments made in Ohio show that ground phosphates when used with manures will give a return equal to that of superphosphates for the same dollars and cents expended. While they use very much less phosphoric acid, the cost is relatively greater.

Mr. Henri D. Haskins (of Amherst). Referring to the basic slag question, have any samples come to your attention that showed a low percentage of lime? In other words, some modern writers on basic slag claim that material made with silica makes the phosphoric acid more available. In Massachusetts we have not run across any of that product.

Dr. Voorhees. We have not.

Professor Brooks. This basic slag is a new thing among the farming community, and we find that this material contains a high percentage of lime, and also contains from 8 per cent to 9 per cent of free lime. It is being imported by some large fertilizer manufacturers, and will be used in the future more than in the past.

Mr. Parmenter. I would like to ask in regard to potatoes, being a large grower, and making this a money crop. We have an elevation of something like 1,900 feet, where we propose to rotate potatoes, oats, or barley and hay, with nothing to supply the food but commercial fertilizers. Is it possible to keep up indefinitely the fertility of that soil along practical lines with commercial fertilizers? What we have been using is one that has 5 of nitrogen, 8 of phosphoric acid and 11 of potash from sulphate.

Dr. Voorhees. I do not think there would be any question but that you could continue it. After a while you will have to use a good deal more fertilizer than now to get a crop, because of the depleted condition due to the growing of potatoes and growing two crops, either hay, oats, timothy or grass. Therefore you are not getting into your soil any organic matter at all, and after a while the physical condition will not be so good as it is now. You will have to use a larger amount of commercial fertilizer. I would suggest that you have a cover-crop in between these, or substitute a cover-crop, preferably legume, for the barley; so that you keep up your supply of organic matter. That helps a whole lot in the absorption and distribution of the fertilizer, and will prevent any possible bad results that come from the continuous application of large quantities of fertilizer. In our State they will grow potatoes for three years, and sometimes even longer, but they have their fields in crimson clover in the spring, and sometimes red clover; they have their land covered all the time, and with a leguminous crop, which helps to keep up the supply of vegetable matter. I do not see any particular reason in your case why potato growing should not be continued by large applications of commercial fertilizer. After a while the conditions might be-

come such as to make it necessary to apply larger quantities of fertilizer.

QUESTION. What do you term a "larger quantity"?

Dr. VOORHEES. Two thousand pounds per acre. You say that at the present time you use about 1,200 pounds per acre. After your potatoes come off there is nothing more on your land until the spring, when the barley comes; and you follow the barley with hay, and then with potatoes again. I should not call that a well-balanced ration.

QUESTION. Do you advise the raising of celery wholly on commercial fertilizer?

Dr. VOORHEES. I would under proper conditions as to moisture and plant food.

Professor BROOKS. I think a large proportion of humus in the soil is essential for celery, and that this can be supplied, in many localities, to best advantage in manures; because the land is assessed at such a value that they cannot take the time to produce a cover-crop, which might accomplish the same results.

Touching Mr. Parmenter's question, I think that, using sulphate of potash, as you are doing, and looking out for lime, if experience indicates your soil has a tendency to become solid, you will have no difficulty in producing your potato crops, because I have so much confidence in the recuperative value of the hay crop, — meaning by that a mixed crop of timothy, redtop and clover; and the clover will be very prominent if you use fertilizers.

Mr. PARMENTER. What is your advice for a cover-crop on our hill?

Professor BROOKS. That is a difficult proposition, because some one who looked at those magnificent fields reported that they were green in October. You will have frost before that time. I don't know of anything you can have there which will give you much green material except rye. But if you follow with oats, you must have rye, because the rye will come up and mix with the oats. Rape is another extremely hardy crop. It is a hard problem for you, because your potatoes occupy the ground so long, and then if you

are going to follow oats next year, you have got to have the oats early. But I don't believe that you will very much need it if you put the land into hay, and clover is a prominent constituent of that hay. I believe that the turning under of the sod will help you out.

Question. How much phosphate would you recommend to the acre in growing a good crop of celery, how many tons?

Dr. Voorhees. We have different conditions in New Jersey; down there all we need is sand and water besides the fertilizers. We use a basic fertilizer of 5 ammonia, 6 available phosphoric acid and 8 of potash, and then depend on top-dressing with nitrogen as nitrate. Apply a ton of basic fertilizer, 1,500 pounds; put on lots of nitrogen. It is astonishing what we can get with nothing but sand, as long as we supply the food to it, and have an abundance of water to keep it growing. A very favorable one is where the water is not far from the surface. Those are ideal spots, and we have a lot of them. We use relatively little manure nowadays in our market garden districts. Even on light sandy soils the farmers use one ton now where they used ten before. They put it on broadcast; but they try to keep the ground occupied with cover-crops, because, if we do not have it occupied, it goes away, and we cannot hold the food in it. So it is a question of necessity with us to have some organic matter there. We use practically nothing but commercial fertilizers.

Question. In consideration of the fact that soils are apt to grow sour under the continued use of fertilizers, would you not substitute common slag and potash.

Dr. Voorhees. There is a general proposition that lime should be applied once in four or five years, not so much to neutralize acidity as to serve as a factor in improving physical conditions, and encouraging the development of organism. Acid conditions of soil bother us very little. We get our acid phosphate for 80 cents a unit, or 4 cents a pound for available phosphoric acid. We have grown corn crops for 15 years with a fertilizer of that sort, without any lime at all, and we could grow clover in it just as well.

Professor Brooks. As to the cost of slag meal, it has been

offered by a company at Worcester for $15 per ton; but in large quantities it can be bought for somewhat less than that. The quantity of phosphoric acid in a ton varies. Fifteen per cent acid phosphate will contain about 13 per cent, or 260 pounds, of available phosphoric acid per ton; but 15 per cent, or less than 15 per cent slag, will give you 15 per cent available phosphoric acid, or 300 pounds available, besides some insoluble, and also a large amount of lime, which is possibly of greater use in our soils than yours. At this price slag meal is a better proposition than the acid phosphate.

The question has been asked about slag taking the place of lime. If, instead of depending on acid phosphate, you will depend on slag meal as a source of phosphoric acid, the soil will continue in good condition as regards lime, and you will not find it necessary to apply lime so often.

QUESTION. Have you determined the available phosphoric acid in slag?

Professor BROOKS. Yes, we have worked at it in two ways, using the methods which they employ in Europe, where they have had much more experience than we have; and those methods show that we have about 15 per cent of available phosphoric acid in the slag. I should say that it would be safe, in general farming, to depend on slag.

On motion, the thanks of the State Board of Agriculture were extended to the Franklin County Agricultural Society, to the Greenfield board of trade for their courtesies during the meetings and banquet, and also to the local delegate, Hon. Frank Gerrett, for his services in getting up the meetings.

The meeting was then adjourned *sine die*.

In the afternoon, members of the Board and others visited the memorial building and other interesting places in the adjoining historic town of Deerfield.

ANNUAL MEETING

OF THE

Board of Agriculture

AT

BOSTON.

January 12 and 13, 1909.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 12, 1909, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by Secretary Ellsworth, and Second Vice-President Bursley assumed the chair.

Present: Messrs. Adams, Avery, Bailey, Bradway, Bursley, Damon, Albert Ellsworth, J. Lewis Ellsworth, Gerrett, Harlow, Heffernan, H. M. Howard, Wm. N. Howard, Jewett, Kilbourn, Lovett, Mason, Millard, Paige, Pease, Peters, Potter, Rane, Richardson, Russell, Smith, Stevens, Tirrell, Trull, Ward, Wheeler and Worth.

The executive committee, as committee on credentials, by Mr. Kilbourn, reported the list of qualified members of the Board for 1909. The newly constituted members are as follows: —

At large, appointed by the Governor, Henry M. Howard of West Newton.

Elected from the —

Amesbury and Salisbury Society, J. J. Mason of Amesbury.

Blackstone Valley, Jacob A. Williams of Northbridge.

Eastern Hampden, O. E. Bradway of Monson.

Hampshire, Franklin and Hampden, Frank P. Newkirk of Easthampton.

Hingham, Henry A. Turner of Norwell.

Hoosac Valley, L. J. Northup of Cheshire.

Housatonic, N. B. Turner of Great Barrington.

Marshfield, Walter H. Faunce of Kingston.

Massachusetts Horticultural Society, Wilfrid Wheeler of Concord.

Massachusetts Society for promoting Agriculture, N. I. Bowditch of Framingham.

Nantucket, John S. Appleton of Nantucket.

Weymouth, T. L. Tirrell of South Weymouth.

Worcester East, George F. Morse of Lancaster.

Elected by the Spencer Farmers' and Mechanics' Association to fill the vacancy caused by the resignation of Noah Sagendorph, Wm. J. Heffernan.

Voted, That the report of the committee on credentials be accepted and adopted.

The secretary presented and read his annual report, which was accepted and placed on file.

The recommendation in the secretary's report, —

That whenever a contagious or infectious disease is reported in the farm of a milk producer, and his milk is shut off from the market, the State should pay for the milk in all such cases, —

was accepted and adopted.

The recommendation in the secretary's report, —

That the secretary appear in favor of a proposed bill amending the nursery inspection law, —

was accepted and adopted.

The recommendation in the secretary's report, —

That the secretary look into the matter of foul brood, and favor any legislation which, in his judgment, shall seem reasonable and likely to be of assistance to the bee keepers of Massachusetts, —

was accepted and adopted.

Voted, That a committee of five be appointed by the Chair to consider the matter of protection from injury done by deer, with instructions to report later in the meeting. The Chair appointed Messrs. Gerrett, Avery, Richardson, Bailey and Harlow.

At 12.40 o'clock a recess was taken to 2 P.M.

The Board was called to order at 2 P.M.

Secretary Ellsworth read a letter from the daughter of First Vice-President Augustus Pratt concerning her father's serious illness.

Voted, That the secretary send greetings to First Vice-President Pratt, with best wishes for his speedy recovery.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted.

The committee on gypsy moth, insects and birds, by Secretary Ellsworth, presented a written report, which was accepted and adopted.

The committee on domestic animals and sanitation, by Dr. Henry E. Paige, chairman, presented a written report, which was accepted and adopted.

Voted, That the matter of change of law so that the Cattle Bureau may have control of the subject of glanders in horses within the limits of the city of Boston be referred to the committee on legislation.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted.

The committee on experiments and station work, by Mr. Smith, presented a written report, which was accepted and adopted.

The committee on forestry, roads and roadside improvements, by Mr. Worth, chairman, presented a written report, which was accepted and adopted.

The committee on institutes and public meetings, by Mr. Bailey, presented an oral report, which was accepted.

The special committee on premium lists of the agricultural societies, appointed at the last annual meeting, by Mr. Bursley, presented a written report, with recommendations.

Voted, That the report lie over until to-morrow.

Professor Rane, State Forester, presented verbally the line of work carried on by his department during the year, which report was accepted.

The State Nursery Inspector, Dr. Fernald, presented his seventh annual report, which was accepted and adopted.

The special committee appointed at the public winter meeting to look into the matter of the San José scale and recommend legislation, by Mr. Wheeler, chairman, presented a written report, with proposed bill, both of which were accepted and adopted.

The report of the State Dairy Bureau was read by the general agent, Mr. P. M. Harwood, and was accepted and adopted.

The special committee appointed at the public winter meeting to consider the subject of cow-testing associations, by Mr. Smith, chairman, presented a written report, with recommendations, both of which were accepted and adopted.

The State Ornithologist, Mr. Edward Howe Forbush, presented his first annual report, which was accepted and adopted.

An abstract of the reports of inspectors of fairs, prepared by direction of the committee on agricultural societies, was read, accepted and placed on file.

The fourteenth semiannual report of the Chief of the Cattle Bureau was read by Dr. Peters, and was accepted.

At 5.40 o'clock the Board adjourned to 9.30 A.M. Wednesday.

SECOND DAY.

The Board was called to order by Second Vice-President Bursley, at 9.45 o'clock A.M.

Present: Governor Draper, Lieutenant-Governor Frothingham, and Messrs. Adams, Appleton, Avery, Bradway, Bursley, Damon, A. Ellsworth, J. L. Ellsworth, Gerrett, Harlow, Heffernan, Howard, Jewett, Lovett, Mason, Millard, Morse, Newkirk, Northup, Paige, Pease, Peters, Potter, Richardson, Russell, Tirrell, Trull, H. A. Turner, N. B. Turner, Ward, Wheeler and Williams.

The records of the first day were read and approved.

Voted, To take the several matters from the table and act upon them.

The matter of requiring each society in the State receiving State bounty to appropriate the sum of $25 for prizes for exhibits at the New England Fruit Show, to be held in Boston in the fall of 1909, was considered, and the proposition was accepted by vote of the board.

The matter of protection from injury by deer was taken up, and Mr. Gerrett, from the special committee, made report and presented a bill.

Voted, To accept so much of the committee's report as allows a farmer to protect his property from damages by deer.

The recommendation of the special committee concerning poultry premiums was taken from the table, and was not accepted.

The recommendation of the special committee concerning paying premiums for specimens of fruit unnamed or incorrectly named was taken from the table, and was not accepted.

At this point His Excellency Governor Draper and His Honor Lieutenant-Governor Frothingham in turn briefly addressed the Board, His Excellency devoting most of his remarks to the cultivation of the apple, in which he said he was especially interested.

The recommendation of the special committee concerning exhibits under owner's name only was taken from the table, and was accepted and adopted.

The recommendation of the special committee concerning paying of premiums for horse trotting was taken from the table, and was accepted and adopted.

The recommendation of the special committee concerning side shows and the like was taken from the table, and was accepted and adopted.

The recommendation of the special committee that the law be amended so as not to make the paying of premiums obligatory upon societies drawing State bounty was taken up, and was accepted and adopted.

Mr. Wheeler, from the special committee, reported verbally on the matter of drainage of the Neponset meadows, and asked that the committee be continued.

Voted, To continue the committee.

Election of officers being in order, the Chair declared His Excellency Eben S. Draper president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First Vice-President, Mr. Augustus Pratt of North Middleborough.

Second Vice-President, Mr. John Bursley of West Barnstable.

Secretary, Mr. J. Lewis Ellsworth of Worcester.

General Agent of the Dairy Bureau, Mr. P. M. Harwood of Barre.

State Nursery Inspector, Dr. Henry T. Fernald of Amherst.

State Ornithologist, Mr. Edward Howe Forbush of Westborough.

Election of specialists being in order, ballots were taken, and the elections resulted as follows: —

Chemist, Dr. C. A. Goessmann of Amherst.[1]
Entomologist, Prof. C. H. Fernald of Amherst.[1]
Botanist, Dr. George E. Stone of Amherst.[1]
Pomologist, Prof. F. C. Sears of Amherst.[1]
Veterinarian, Dr. James B. Paige of Amherst.[1]
Engineer, William Wheeler of Concord.

The secretary appointed his first clerk, Mr. F. H. Fowler, librarian for the ensuing year.

A proposition to establish a fund to be known as the "Institute Prize Fund" was presented but failed of acceptance, and on motion was referred to the committee on institutes and public meetings, with instructions to report at some future time.

Voted, That a committee of three be appointed by the Chair and secretary to represent the Board at the New England Fruit Show. The Chair appointed Messrs. Wheeler, Jewett and Howard.

Mr. Trull extended to the Board an invitation of the trustees of the Middlesex North Agricultural Society to hold the next public winter meeting of the Board in Lowell.

Voted, To accept the invitation and to hold the next public winter meeting in Lowell.

Voted, To leave the matter of holding summer meetings to the discretion of the secretary.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. John Bursley of West Barnstable, Augustus Pratt of North Middleborough, C. D. Richardson of West Brookfield, Henry E. Paige of Amherst, O. E. Bradway of Monson,

[1] Massachusetts Agricultural College.

Henry S. Pease of Middlefield, John J. Mason of Amesbury, Charles E. Ward of Buckland.

Committee on agricultural societies: Messrs. O. E. Bradway of Monson, Albert Ellsworth of Athol, T. L. Tirrell of South Weymouth, Wm. B. Avery of Charlemont, J. A. Williams of Northbridge.

Committee on domestic animals and sanitation: Messrs. Henry E. Paige of Amherst, Walter A. Lovett of Oxford, F. A. Russell of Methuen, W. A. Harlow of Cummington, L. J. Northup of Cheshire.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, F. A. Russell of Methuen, B. W. Potter of Worcester, Geo. W. Trull of Tewksbury, Wm. J. Heffernan of Spencer.

Committee on Dairy Bureau and agricultural products: Messrs. C. D. Richardson of West Brookfield, W. C. Jewett of Worcester, Henry E. Paige of Amherst, George O. Millard of Blandford, Walter H. Faunce of Kingston.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, W. C. Jewett of Worcester, Isaac Damon of Wayland, Frank Gerrett of Greenfield, N. B. Turner of Great Barrington.

Committee on experiments and station work: Messrs. Henry S. Pease of Middlefield, N. I. Bowditch of Framingham, T. L. Tirrell of South Weymouth, J. L. Smith of Barre, Wilfrid Wheeler of Concord.

Committee on forestry, roads and roadside improvements: Messrs. J. J. Mason of Amesbury, F. Wm. Rane of Boston, John S. Appleton of Nantucket, Frank P. Newkirk of Easthampton, Henry A. Turner of Norwell.

Committee on institutes and public meetings: Messrs. Chas. E. Ward of Buckland, Kenyon L. Butterfield of Amherst, J. F. Adams of West Tisbury, H. M. Howard of West Newton, George F. Morse of Lancaster.

These appointments were confirmed by vote of the Board.

The Chair appointed Messrs. Trull, Mason and Russell as a local committee on the public winter meeting, to act with the committee on institutes and public meetings.

Voted, On recommendation of the committee on agricultural societies, that the date for holding the fair of the Worcester County West Agricultural Society be changed to the fourth Thursday after the first Monday in September,

and that of the Weymouth Agricultural and Industrial Society to the second Thursday after the first Monday in September.

The committee on agricultural societies, by Mr. Bradway, reported the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 28, 29 and 30,	F. P. Newkirk.
Barnstable County, at Barnstable, August 31 and September 1 and 2,	J. J. Mason.
Blackstone Valley, at Uxbridge, September 21 and 22,	T. L. Tirrell.
Deerfield Valley, at Charlemont, September 16 and 17,	J. A. Williams.
Eastern Hampden, at Palmer, October 8 and 9,	W. B. Avery.
Essex, at Peabody, September 21, 22 and 23,	H. S. Pease.
Franklin County, at Greenfield, September 22 and 23,	L. J. Northup.
Hampshire, at Amherst, September 21,	W. A. Faunce.
Hampshire, Franklin and Hampden, at Northampton, October 6 and 7,	G. F. Morse.
Highland, at Middlefield, September 8 and 9,	W. Wheeler.
Hillside, at Cummington, September 28 and 29,	W. C. Jewett.
Hingham, at Hingham, September 28 and 29,	C. E. Ward.
Hoosac Valley, at North Adams, September 9, 10 and 11,	B. W. Potter.
Housatonic, at Great Barrington, September 29 and 30 and October 1 and 2,	J. F. Adams.
Marshfield, at Marshfield, August 25, 26 and 27,	W. J. Heffernan.
Martha's Vineyard, at West Tisbury, August 30 and 31 and September 1,	F. Gerrett.
Massachusetts Horticultural, at Boston, September 17, 18 and 19 and October 19, 20, 21, 22, 23 and 24,[1]	J. L. Smith.
Middlesex North, at Chelmsford, September 15 and 16,	Ge. O. Millard.
Middlesex South, at Framingham, September 21 and 22,	G. W. Trull.
Nantucket, at Nantucket, August 25 and 26,	A. Ellsworth.
Oxford, at Oxford, September 2 and 3,	F. A. Russell.
Plymouth County, at Halifax, September 15 and 16,	W. A. Lovett.

[1] In connection with the New England Fruit Show.

Spencer, at Spencer, September 23 and 24, .	W. A. Harlow.
Union, at Blandford, September 15 and 16, .	J. S. Appleton.
Weymouth, at South Weymouth, September 16, 17 and 18, ...	N. B. Turner.
Worcester, at Worcester, September 6, 7, 8 and 9, ...	J. Bursley.
Worcester East, at Clinton, September 15, 16 and 17, ...	H. E. Paige.
Worcester Northwest, at Athol, September 6 and 7, ...	O. E. Bradway.
Worcester South, at Sturbridge, September 16 and 17, ...	H. A. Turner.
Worcester County West, at Barre, September 30 and October 1, ...	I. Damon.

The report of the committee was accepted and adopted.

Voted, That any unfinished business or new business that may arise be referred to the executive committee, with power to act.

The records of the second day were read and approved.

The meeting was dissolved at 12.50 P.M.

J. LEWIS ELLSWORTH,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

The committee on agricultural societies have examined the reports of the inspectors of fairs.

All report successful, well-managed fairs, with no objectionable features, and commend the arrangements made by the officers of the societies. In almost all cases the weather was favorable, the attendance large and the receipts greater than the expenses.

The institutes have in general been better attended than in former years, and we believe the increased attention which some of the societies have given to the institutes has been well repaid by improvement in interest and usefulness.

WILLIAM A. KILBOURN.
ALBERT ELLSWORTH.
O. E. BRADWAY.
T. L. TIRRELL.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

Your committee visited the Massachusetts Agricultural Experiment Station, at Amherst, on Oct. 29, 1908, and made an inspection of the work being carried on by the station. We feel, however, owing to the short time which we had to devote to this visit, and our comparative unfamiliarity with the work, that we cannot see our way clear to make any recommendations, or extended comment, on the work of the station. We were very much interested in the work shown to us, and were especially impressed with the experiments being carried on in orchard management and the growing of clover, where low-grade sulphate of potash seems to have demonstrated its value as a fertilizer for these uses. The grass plots in general form an exceedingly interesting exhibit and worthy of more extended investigation. We would recommend that the committee for 1909, however it may be composed, spend at least two days in investigating the work of the station.

It was manifest that the entomological department was in great need of better and more extensive quarters, both for its experiment working and for teaching and laboratory work. We understand that the trustees of the college have asked for an appropriation for the building of proper accommodations for this department from the present Legislature. We would recommend that this Board, through its secretary and legislative committee, or such other officers as it may appoint, urge upon the Legislature the necessity for the making of a suitable appropriation for this purpose.

The new greenhouses were under construction at the time

of your committee's visit and give promise of affording excellent facilities for experiment and teaching work. They appear to be laid out in a practical manner, good working greenhouses, which can be used as models for instruction and inspection.

There has been more or less agitation of late on the question of experiment work by the various agricultural societies, either as a susbtitute for or in connection with their general work in the way of fairs and institutes. Your committee is not prepared to say whether such action would be wise, but we do believe that if such action is taken the societies should be safeguarded in every possible way against duplication of work and careless work, and that they should not be allowed to enter into indiscriminate work in this matter, but should be held strictly accountable to the Board, and should only conduct such experiments as meet with its approval.

We would, in conclusion, commend the work of the Massachusetts Agricultural Experiment Station in general, and recommend that the Board heartily support that institution in any call for funds from the State or for assistance in any other manner which is within its power.

Respectfully submitted,

JOHN L. SMITH.
T. L. TIRRELL.
HENRY S. PEASE.

Report to the Legislature of the State Board of Agriculture acting as Overseers of the Massachusetts Agricultural College.

[Revised Laws, chapter 89, section 10; adopted by the Board Jan. 12, 1909.]

The majority of the committee visited the college in June at the time of commencement, and it was then that the Grinnell prizes were awarded to John Daniel of Osterville and Clifford Dolan of Hudson.

At our visit in October, the increase each year of the number in the entering class indicated to us that our young men appreciate the education our college gives, and to better furnish this education more facilities are needed, and we hope the Commonwealth will continue its wise policy of trying to provide the best, so that at this institution, situated in one of the fairest sections of the State, we may still fit the young man for a practical life work.

The increased interest in floriculture is being provided for by a new building for classes and the new glass houses for demonstration work. Clark Hall has a glass house added to better accommodate the botanical department.

Whatever course may be decided upon by the present Legislature the college will be hampered for suitable barn room for a year at least, owing to the burning in August of the one that had been completed so short a time. If the Commonwealth is to continue its policy of placing no insurance on its buildings, then it surely ought to create an emergency fund for use on occasions like this.

The entomological building must be supplanted by a modern fireproof building, with accommodations for a much larger number of students than are being provided for at present. With the rapid increase of destructive insects, this

branch of our college work must be kept well to the front if we are to succeed in their extermination.

The summer school was well attended and served to create an interest in the college that could not be acquired in any other way. Grammar and high school teachers who spend a few weeks here do a large amount of valuable advertising for the institution.

With the new buildings and equipment now being installed and those which must be provided in the near future, our college will be in a position to give our young men an education that will well fit them for the battle of life; but with all that is being furnished care must be taken to teach them the practical, that they may be able to make the best use of all they have secured.

Respectfully submitted,

JOHN BURSLEY.
W. C. JEWETT.
ISAAC DAMON.
FRANK GERRETT.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

Your committee continues to take an unabated interest in the suppressing of the gypsy and brown-tail moths, having both individually and as a committee visited the infested area at various times during the year, and endeavored to keep in as close touch as possible with the work. On June 30, 1908, your committee, together with many other members of the Board, made a visit of inspection to the infested territory, beginning with the north shore woods, in Beverly, at and near the Montserrat railroad station. Here we witnessed a very interesting demonstration of what might be done with power pumps for spraying, and noted the general condition of the territory in that vicinity. From there your committee went to the laboratory of the superintendent in charge of the work, at Melrose Highlands, where the experiments in connection with the breeding of parasites, both imported and domestic, are being carried on, and made a careful inspection of this work.

We are convinced that the work of the year has brought excellent results, so far as a system which we never approved, of divided authority and responsibility, could bring such results. Your committee is not prepared to say that the work is on a firm footing as yet, for while we readily acknowledge that excellent work has been done in the residential sections and along the roadways, we cannot but feel that the unchecked, or practically unchecked, spread of the gypsy moth in the central woodlands forms a menace to the woodland and orchards of the State which is far from being under the control that we would like to see exist. We would not

be understood as imputing blame to those in charge of the work, for we know too well its difficulties, particularly under the present system. Nor would we be understood as in any sense retreating from the position which we have held from the outset of the resumption of the work, indeed from the discovery of the gypsy moth in Massachusetts, — that everything possible should be done by the State to suppress it. We would simply point out that the work, excellent as it has been, has suffered, and still suffers, from the defect of being only partial, that all has not been done, because it could not be done, that should have been if the work of suppression was to be a certain success. Suppression is only half-way work at best; the only certain suppression is attempted extermination; and we say again that to point out this is not to criticise those in charge of the work, or to argue for its abandonment or for the relaxing in any way of the efforts now making by all the agencies in charge of the work.

The scouting operations carried on under the direction of the superintendent of the work during the early part of 1908, when nearly 100 trained employees were engaged in searching for the moth beyond the borders of the known infested district, showed that the insect had become established in small colonies as far west as Springfield. We are informed that many of these small infestations now appear to be stamped out. We heartily approve of the policy of thoroughly examining the outlying towns and cities, as an incipient colony, if found, may often be exterminated in a single year, and at a small expense, whereas if the colonies are allowed to grow until they are forced to the attention of the authorities, an annual outlay of several thousand dollars is necessary in most cases.

We have noticed with regret the increasing devastation by the gypsy moth in the woodlands of low valuation near the metropolitan district. These woodlands, held often for speculative purposes, and usually covered with scrub growth, have suffered severely by the gypsy moth, and naturally serve as breeding places from which the insects may be transported into sections previously clear of the moths. The thinning or spraying of protective belts on the borders of

such woodland colonies, the policy adopted, seems to be that best suited to the needs of the case.

During the past year it has been practically demonstrated by those experimenting with the insect that during the early stages of the gypsy moth caterpillar's life it cannot live on white pine alone. For the first two weeks or more of the caterpillar's existence it requires the more tender foliage of hard-wood trees or shrubs. The field experiments of the past year have demonstrated that by keeping pine plantations free from hard-wood growths, and by properly banding with sticky materials the trees on the borders of such plantations, damage by the gypsy moth to white pine can be entirely prevented. This is of the first importance, as it shows that one of our most valuable timber trees can still be grown, even in the midst of infested territory, if its owners will take the necessary precautions.

Dr. L. O. Howard has continued to direct the work of importing the European and Asiatic parasites found preying upon the gypsy moth. We are informed that many thousands of these insects have been liberated in the infested district, and that several important species have already established themselves. We hope that the final results of this experiment may be all that its most sanguine promoters claim for it, though we confess to grave doubts as to its having such a satisfactory outcome. Your committee is, as from the first, somewhat skeptical of the value of these imported parasites. Nevertheless, the experiment is one that should be continued. Certainly it is the only hope we have of the final destruction of the gypsy moth, or even, we fear, its reduction to the point where it is less of a menace to the country than it is to-day. Therefore these experiments in importation and breeding of parasites should be continued, without stinting of means, far beyond the point where we can say that it is demonstrated that they are not a success; like work over a drowned person, they should be continued so long as there is the slightest possible hope of success. Certainly they are not so well established at present that we can afford to forego in any degree the efforts now being made in the way of field work.

The brown-tail moth seems to be established firmly in the

position of a permanent pest. Moving freely to and fro, by reason of its excellent flying powers and the strong winds usually prevailing at its time of flight, it seems impossible that anything can be done to hold it permanently in check. Nevertheless, being in plain sight for six months of the year, it can be combated by private individuals without too great expense. As a leaf-eating pest it is surpassed by many of our native insects, and, being quite susceptible to insect and fungous parasites, we should doubtless have long ago resigned ourselves to its presence with comparative calmness if it were not for the nettling which it causes to the skin with so many of us, which when it occurs makes calm resignation the last virtue we are likely to exercise. Still we may look for it to become less and less a pest from year to year.

The San José scale, mentioned by your committee for the first time in its report of last year, deserves the careful study and attention of every one interested in even the slightest degree in orcharding. It is so small as to be almost microscopic, and for that reason is extremely difficult to detect when it first appears, but from a few scattered scales in the orchard, so prolific is it, we soon have a general infestation, with dead and dying trees and general damage resulting. It therefore behooves every orchardist to be sure that he receives into his orchard only such trees as have been fumigated with hydrocyanic acid gas, or bear the stamp of inspection of a competent official, and also, as the insect may be carried from orchard to orchard on the feet of birds, to make a careful yearly inspection of his trees, to make sure that it has not effected a lodgment.

The elm-leaf beetle seems to have been unusually prevalent during the summer of 1908, and to have done a great deal of damage to the shade trees of many cities and towns. Spraying in the early summer seems to be the only course by which this insect can be held in check, but it is also an extremely effective one, and wherever adopted and conscientiously attended to the results have been entirely satisfactory. This Board has issued an excellent nature leaflet on this insect, by A. H. Kirkland, M.S., which is for free distribution to whoever may be interested in it.

Last year your committee, together with the secretary of

the Board, recommended that the office of State Ornithologist be established. We are glad to be able to say that the Legislature paid heed to the general call which there seemed to be for some more systematic and regular work on birds and their protection, and established this office, under the direction of the State Board of Agriculture. It has been filled during the part of the year remaining after the passage of the legislation by Edward Howe Forbush, for many years the unpaid ornithologist of the Board, and an extremely careful and competent public official. We look to see so much good work done on this subject by Mr. Forbush and those whom he may interest that the work will increase from year to year to such an extent that it may presently require a much larger appropriation for its proper carrying on.

Respectfully submitted,

FREDERICK A. RUSSELL.
BURTON W. POTTER.
GEORGE W. TRULL.
J. LEWIS ELLSWORTH.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

While the field of investigation assigned to your committee is covered by the Chief of the Cattle Bureau of the State Board of Agriculture in detail, in the performance of his duties, and a report is submitted by him semiannually to this Board, we however desire to call your attention, very briefly, to one or two matters that seem to us to be of particular importance.

Notwithstanding the unsanitary conditions under which most of our domestic animals are kept, more especially cows, from which the bulk of our milk supply for human consumption comes, it is apparent that within the past few years there has been a decided change for the better in this respect among our farmers, and improvement in sanitary conditions on our farms is quite noticeable. Where new stables are being erected there is a tendency on the part of the owners to introduce those features that provide for better lighting, more effective ventilation and more sanitary disposal of the animal excrement. In addition, in many sections of the State we have found that stock owners are remodeling old stables that have been unsatisfactory, both from a sanitary and economical standpoint, and have introduced many features, making the stables more sanitary and less expensive to operate and maintain. Your committee is convinced that there is a general tendency among the stock owners and milk producers to respond to the call of the public that our domestic animals be given better care, and that the milk for human consumption be produced under more cleanly and

sanitary conditions. With this improvement on the farms the farmers have a right to expect that there shall be an increased income from the sale of the animal products.

With the recurrence of foot and mouth disease among the cattle of the country it is encouraging to be able to report at this time that, through the efficiency of our national and State authorities, under whose jurisdiction matters of this nature come, the disease has not gained a foothold in Massachusetts. Although the disease has been found to exist only in New York, Maryland, Pennsylvania and Michigan, the restrictions that have necessarily been imposed by national and State authorities, limiting the shipment of cattle, has to a slight extent interfered with our milk producers obtaining such additions to their herds as are necessary to enable them to maintain the production of the amount of market milk needed to supply the trade.

The occasional occurrence of the disease glanders among the horses in the rural districts is a matter of such importance as to warrant a brief reference to it by your committee. It is usually found that horses in which this disease manifests itself are of recent importation from some of the large cities of the State, more especially Boston, or that it occurs among animals that have been in close contact with these recently imported horses. Barring this source of introduction, it is doubtful if the disease would be often found among the horses on the farm or among those in the rural districts of the State. In many instances it is possible to trace the animal that acts as the center of infection in these occasional outbreaks to a horse that has been recently purchased at one of the city sale stables. It seems advisable in this report to call the attention of farmers to the dangers that exist in connection with the purchase of animals from such sources, more especially the purchase of second-class animals that have for some time been kept in city stables, that are liable to contain the infectious principle of this dangerous disease.

Your committee so firmly believes that the majority of the cases of glanders developing among the horses of the rural

sections are traceable to this source of infection that it desires to recommend to the Board that a committee of three be appointed who shall endeavor to secure the passage of a legislative act that shall give the Chief of the Cattle Bureau of the Board such authority as is necessary to enable him to have control of this branch of animal sanitation work in the city of Boston.

H. E. PAIGE.
A. M. STEVENS.
W. A. LOVETT.
F. A. RUSSELL.
W. A. HARLOW.

COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

Your committee desires to submit the following brief report.

Since our last meeting the following enactments by the General Court have been made: —

I. Forestry: —
  (*a*) Reforestation act. (Chapter 478, sections 1–10.)
  (*b*) Forest fire protection act. (Chapter 209, sections 1–5).
  (*c*) Revised Laws on exemption of reforested land from taxation. (Chapter 120, section 6.)
  (*d*) A Resolve authorizing the sale of certain publications of the State Forester. (Chapter 121.)

II. Roads and roadside improvement: —
  (*a*) An Act relative to shade trees. (Chapter 296, sections 1–6.)
  (*b*) An Act relative to trees, shrubs and other growths on State highways. (Chapter 297, sections 1 and 2.)

This new legislation is timely, and, it is believed by your committee, will prove of great value in improving our forestry conditions, and in embellishing our roadsides and making conditions more in keeping with what they should be throughout this Commonwealth.

We will not go into a detailed report on the forestry work as the State Forester's report, which will be discussed by him before this Board, will cover this ground.

While we recognize the splendid work being carried out by our tree warden act, and realize that the new legislation

will be of great assistance to that officer in our various towns, nevertheless we are convinced that far better results can come by a more central organization, with a definite official head, similar to that now being carried out in the case of the forest wardens, under the State Forester.

Respectfully submitted,

H. G. WORTH.
J. J. MASON.
F. W. RANE.
WM. N. HOWARD.
H. A. OAKMAN.

REPORT OF SPECIAL COMMITTEE ON REVISION OF PREMIUM LISTS.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

The special committee on the revision of the premium lists of the agricultural societies met at the office of the State Board of Agriculture on Nov. 5, 1908, at 11 o'clock A.M.

Present: Messrs. Pratt, Bursley and Mason.

Voted, To recommend that the State Board of Agriculture prohibit the offering of premiums by the agricultural societies for "any other variety" of poultry, the premiums in the poultry classes to be confined to the varieties specifically mentioned in the premium lists.

Voted, To recommend that the State Board of Agriculture prohibit the societies from paying premiums for specimens of fruit unnamed or incorrectly named.

Voted, To recommend that the State Board of Agriculture prohibit the societies from paying premiums on animals or fowls except where the same are actually the property of the person exhibiting them.

Voted, To recommend that the Board prohibit the societies from including in their returns of premiums paid the sums paid out in the horse trotting classes, except where the said classes are confined to animals bred or owned within the limits of the county where the society is located.

Voted, To recommend that the State Board of Agriculture require that officers of agricultural societies use all due care in regard to the legal and moral status of the side shows, etc., to which they rent the grounds of the societies during the fairs, and that in case of anything finding lodgment on the grounds which savors in the least of immorality or illegality

the officers be required to remove the same at once on discovering its existence.

We recommend that the law in relation to agricultural societies be so far amended as to allow the societies to obtain the bounty and expend the same for premiums at fairs, or for experimental or educational work, within the limits of the society, upon petition by the society to the State Board of Agriculture and approved by said Board.

H. M. HOWARD.
JOHN BURSLEY.
JOHN J. MASON.

REPORT OF THE SPECIAL COMMITTEE ON THE SAN JOSÉ SCALE.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

This committee, consisting of Messrs. Wheeler, Rane and Fernald, met in the rooms of the State Board of Agriculture on Monday, January 11, at 2 o'clock P.M., and submitted the following report: —

Resolved, That this committee recommend the following bill to this Board for its approval; which bill is to be presented to the Legislatures of the several New England States this winter, so that uniform laws may be adopted by the several States for the control of the San José scale and other serious pests and diseases on nursery stock.

A synopsis of this bill will be as follows.

The bill has been modified from our present law in order to make it uniform with similar bills to be presented this winter in all of the New England States. The only new features are: —

1. Licensing of agents without fee.

2. Requirement that nurserymen not residing in Massachusetts shall register with nursery inspector before shipping goods into the State.

3. Infested stock may be quarantined, even though under certificate.

4. Stock endangered by the presence of infested trees may be declared a public nuisance.

5. The new provisions necessary in order to make the laws uniform may require a slight added expense.

REPORT OF SPECIAL COMMITTEE ON FORMING COW-TESTING ASSOCIATIONS.

[Read and accepted at the Annual Meeting, Jan. 12, 1909.]

Your committee, appointed at the winter meeting of the Board in Greenfield to consider the matter of cow-testing associations in this State, have attended to their duty and beg leave to submit the following report.

There is no question but that such associations, if rightly organized and wisely conducted, would be of great benefit to the owners of dairy cattle and to the public at large. The testing of the cows would without doubt increase their value, and also improve the breeding of our dairy stock. These associations have been in existence many years in Denmark and other great dairy countries. The Canadian government has for a decade or more been doing everything in its power to improve the agricultural conditions and to enlarge the agricultural products of that country. It is standing substantially all the expense of a yearly test of the pure-bred cattle in the Dominion. In the bulletin of the rules and regulations governing such cow testing the following language is used: —

It is recognized that improvement of the milking herds of this country is largely dependent upon the dairy qualities bred in the sires employed from year to year. It is recognized, further, that all pure-bred dairy sires do not possess inherited dairy qualities of a high order. So-called dairy form and show ring characteristics are frequently found in sires that do not possess inherited powers of high milk production. Breeders of grade milking herds anxious to improve their cattle have frequently been sorely disappointed in the progeny of even high-priced sires of this character. It was to guide dairy farmers in the selection of sires that could be depended upon to improve their herds that the record of performance was put into operation.

And the following rules and regulations govern the record of performance tests: —

Duties of Owner. — The owner of a cow entered in the test shall weigh, or cause to be weighed, each milking, and keep a correct record of the same on forms furnished for the purpose.

At the end of each month the owner shall report on forms furnished for the purpose: —

(*a*) A record of the weights of each milking, with the total yield of milk from each cow for the month.

(*b*) An approximate statement of the amount and kinds of feed given, and data concerning stabling and care given the animals.

At the end of the year the owner shall send on forms furnished for the purpose a complete report of the year's milk record, taken from the monthly reports and sworn to before a notary public or justice of the peace.

The owner of the cow entered in the test shall provide board and lodging for the inspector during his official visits, and shall convey him, when leaving, to the railway station, or the next farm to be visited, free of charge.

Duties of Inspectors. — An inspector will visit the stable at least eight times during the year, at irregular intervals and unannounced. He shall remain for at least two full days, covering all the milkings of that period, at each visit. During this time he shall weigh the milk of each cow under test at each milking, and take samples of each for composite sample for a Babcock test. These tests shall be the basis for computing the record. He shall see that the samples are in no manner interfered with; when not under the inspector's eye the samples must be under lock and key or sealed. The inspector may insist upon only one of the animals under test being milked at a time during inspection.

The inspector shall take a copy of the owner's milk record for the two days immediately preceding his visit. Dates of calving, service, etc., must be recorded by him. As complete a statement as possible of the feed given should be reported. Any sickness of cows and other disturbing influences shall be noted. If such sickness of an animal should occur at the time of a visit, the inspector may defer the test of this animal to another date.

The inspector must send to the Live Stock Commissioner, Ottawa, as soon as possible after each visit, a report of said visit, on forms furnished for the purpose.

We cite these rules and regulations for the purpose of showing what is being done by cow-testing associations in a country where they are in full operation.

Your committee therefore recommends that our secretary and the Board ask the Legislature of our State for an annual appropriation of $2,000, to be expended under the direction and authority of the Dairy Bureau in assisting the formation of cow-testing associations in the places in the State where the dairymen show a disposition to organize such associations, and to carry them on under such reasonable rules and regulations as the Dairy Bureau or this Board on appeal may establish for the yearly test of grade and pure-bred cows.

JOHN L. SMITH.
BURTON W. POTTER.
ISAAC DAMON.

SEVENTH ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JANUARY 12, 1909.

SEVENTH ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to submit herewith the seventh annual report of the State Nursery Inspector.

During the inspection season, from the first of July till the completion of the work in October, 137 different places were visited by the inspectors, not counting blocks of stock located within a mile of each other, these places being parts of 126 different nurseries. Four nurseries have gone out of business since the last report; 2 have no stock for sale this year; 3 fumigate all stock sold; 1 has received a certificate for ornamental stock and a second for fumigated fruit stock, this having been inspected three weeks after fumigation, the results of which were satisfactory; 1 has received a certificate for ornamental stock only; 4 have failed to comply with the requirements of the law, and have, therefore, been refused certificates; and 111 full certificates have been given.

The approach of the gypsy moth to a number of nurseries during the last few years has been carefully watched. During the past season it has reached 5 of these and is dangerously near 4 others. This is a very serious condition, for 5 of these 9 do a large business, not only in Massachusetts but also in other States. A conference with the superintendent of the gypsy moth commission concerning the situation has resulted in a ruling that no certificate of inspection will be given hereafter to any nursery in which the gypsy moth is found until after an inspection, made as late as September 15 of each year, as the insect might enter a nursery after the inspection had been completed if it were made before this date.

Another serious fact in connection with the work is that

the San José scale is present, in or near at least 25 nurseries. In some cases it is on orchard or other trees among which the stock is planted; in others it is on adjoining premises. So long as it is not present on the nursery stock, however, the inspectors have no power, except in an advisory capacity, the law applying only to nursery stock itself. It is only fair to state that most of the nurserymen concerned fully recognize the seriousness of this condition, and do all in their power to control the scale on their own premises by repeated spraying, and in many cases they have removed all infested trees. Across the fence, however, on the property of their neighbors, the problem is more difficult and the results are less satisfactory. As a consequence, such nurserymen pay an annual tax by the fumigation or destruction of all infested stock found by the inspector on his visit.

In inspection work it is necessary to keep in mind that the inspection is for two purposes: first, the protection of buyers residing in Massachusetts; and second, compliance with the laws of other States into which nursery stock may be shipped from here. As the laws of different States vary quite widely this is sometimes difficult, and the Association of Horticultural Inspectors has, for some time, been attempting to obtain a national law applying to all imports into this country, and also to interstate shipments. If successful, this should result in greater uniformity, and also in a larger degree of protection, and such a law is much to be desired. Unfortunately there seems to be no immediate prospect that it can be secured.

Another present difficulty which the inspector meets is that he does not inspect or even know of some of the stock sent out under his certificate. He may inspect every plant present in the nursery at the time of his visit, but when orders for shipment are to be filled it is rarely the case that a nurseryman has everything which may be ordered. He therefore sends elsewhere (frequently outside the State) for what he lacks, distributes this stock among his different shipments and sends each of these out with a certificate intended to cover only the stock he himself raised. It is true that the purchased stock is accompanied by a certificate from the

State whence it comes; but it is also true that inspectors differ in the thoroughness with which they do their work, and therefore some certificates mean more than others. During the past fall five complaints of the receipt of infested stock from Massachusetts have been made. In three of these cases only a small portion of the shipment was infested, and this portion was found to have been bought by the nurserymen; in other words, the infested stock had never been seen by the inspector under whose certificate it was finally sent out. In the other two cases the source of the infested stock could not be learned, and it is only fair to say that inspectors are not infallible, and that they may and certainly do miss more or less stock which is infested.

At the conference of the Governors of New England last November, one topic considered was that of developing the industry of fruit raising. After some discussion this was referred to representatives of the Boards or departments of Agriculture of the different States and to the State entomologists. A meeting of these followed, and it became evident that a distinct advantage could be obtained by establishing laws which, so far as possible, would be uniform throughout New England, and the nursery inspectors were requested to formulate such a law. This work has been completed by them after numerous sessions and consultations with the nursery inspectors of other parts of the country, and the result, in the form of a new law governing nursery and orchard inspection in Massachusetts, has been presented to a committee of the Board appointed to consider this subject. I would recommend that the Board adopt the recommendation of the committee, and urge the passage of the bill by the present Legislature as a substitute for the one now in force.

FINANCIAL STATEMENT.

Appropriation,		$2,000 00
Compensation of inspectors,	$960 00	
Travelling and necessary expenses of inspectors,	772 83	
Supplies (postage, etc.),	3 45	
Unexpended balance,	263 72	
		$2,000 00

It gives me great pleasure to again express my thanks for the assistance in this work given by the secretary of the Board, and by all connected with it.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Jan. 11, 1909.

FOURTEENTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS STATE BOARD OF AGRICULTURE.

FOR THE YEAR ENDING NOV. 30, 1908.

REPORT.

To the State Board of Agriculture.

The fourteenth semiannual report of the Chief of the Cattle Bureau, as required by section 3 of chapter 116 of the Acts of 1902, is herewith respectfully submitted to your honorable Board.

This report gives in detail an account of the work of the Cattle Bureau for the fiscal year from Dec. 1, 1907, to Dec. 1, 1908.

During the past year there have been a number of conventions and conferences of special importance to the interests represented by the Cattle Bureau, to which delegates to represent the Commonwealth have been appointed by His Excellency the Governor.

The first one of these was a conference of the live stock sanitary authorities of the New England and some of the eastern States, held at the Hotel Victoria, New York City, March 12. At this meeting representatives of the cattle commissions of Maine and New Hampshire were present, also delegates from the Cattle Bureau of the Massachusetts State Board of Agriculture, the secretary of the Rhode Island State Board of Agriculture, three veterinarians from the New York State Department of Agriculture, three delegates from the New Jersey Tuberculosis Commission and three veterinarians from the Pennsylvania Live Stock Sanitary Board, and also the Chief of the United States Bureau of Animal Industry. His Excellency the Governor appointed the Chief of the Cattle Bureau, Mr. C. A. Dennen and Dr. Howard P. Rogers to represent Massachusetts at this conference.

While there is already in existence a body known as the

Interstate Association of Live Stock Sanitary Boards, which meets annually in September, in which any State is entitled to membership from the body analogous to the live stock sanitary board, yet the New England and eastern States have never been generally represented at its meetings, therefore it was decided at the conference in New York to form an association, with a membership composed of representatives from the New England States, New York, New Jersey and Pennsylvania, to discuss annually matters specially relating to the protection of the health of the live stock in these States.

It was decided to christen this body the Eastern Live Stock Sanitary Association. A constitution and by-laws were adopted and officers elected as follows: —

President, Dr. Leonard Pearson, Pennsylvania.

Vice-President, Hon. H. O. Hadley, New Hampshire.

Executive Committee: Hon. John M. Deering, Maine; Hon. Franklin Dye, New Jersey; Dr. Wm. Henry Kelly, New York.

Secretary-Treasurer, Dr. Austin Peters, Massachusetts.

It was also decided to meet annually to discuss measures of mutual benefit to the live stock sanitary interests of the States entitled to membership. The Chief of the United States Bureau of Animal Industry was also elected a member.

A little later in the spring the Governor appointed Dr. Howard P. Rogers, an agent of the Cattle Bureau and an expert on glanders, to attend a conference in Pennsylvania, with the Chief of the United States Bureau of Animal Industry, the State veterinarian of Pennsylvania and representatives from the Pennsylvania Live Stock Sanitary Board and the New York State Department of Agriculture, for the purpose of investigating suppurative or contagious lymphangitis in horses, a disease which may be mistaken for farcy by any one not conversant with it. Dr. Rogers saw a number of cases of this disease and brought home specimens from horses killed because of it for further study at the laboratory at the Harvard Medical School. It is undoubtedly of great value to the Commonwealth to have an agent of the Cattle Bureau made familiar with a disease which might be mis-

taken for farcy, and one which might be troublesome if it should appear in this State.

At present there is no legislation which would permit of the Cattle Bureau taking any action if this disease should be imported into Massachusetts, and, if there were, the provision of the law which divides the Commonwealth into the State of Massachusetts and the city of Boston so far as glanders and farcy is concerned would only complicate matters, as suppurative lymphangitis is a disease frequently mistaken for farcy.

The latter part of September and early in October the Chief of the Cattle Bureau was present at the International Congress on Tuberculosis at Washington, which he attended as a delegate to represent the Cattle Bureau, by authority of His Excellency the Governor.

Space does not permit giving a detailed account of this great gathering, with representatives from most of the civilized countries on the globe, among them many of the leading scientists of continental Europe, England and America. The meetings were held in the New National Museum building, which was not at the time completed, where there was a great deal of noise and not very good accommodations for meetings of this kind.

The meetings were held in sections and occupied several days, commencing Tuesday, September 29, and continuing during the week. Section VII. was upon "Tuberculosis in Animals and its Relation to Man," under the presidency of Dr. Leonard Pearson of Pennsylvania. Among the vice-presidents Massachusetts was represented by Drs. Theobald Smith, Langdon Frothingham and the Chief of the Cattle Bureau.

Among the papers read at this section was one by the Chief of the Massachusetts Cattle Bureau, giving a historical sketch of the agitation in this State in regard to bovine tuberculosis and the work done as a result. It was a condensation of a chapter written for a book called "Tuberculosis in Massachusetts," edited by Dr. Edwin A. Locke and published by the Commonwealth for distribution among delegates to the congress. The title of this chapter is "Bovine Tuberculosis

in Massachusetts, a History of the Earlier Agitation concerning it, and Efforts of the State for its Eradication and Control."

October 12 and 13 the Chief of the Cattle Bureau was present at a conference on hog cholera, at Ames, Ia., which he attended by authority of His Excellency the Governor, to represent the Cattle Bureau of the Massachusetts State Board of Agriculture. This conference was one of a series of similar conferences held at an experiment station of the United States Department of Agriculture at Ames, attended by delegates from different States, invited there by the Chief of the Bureau of Animal Industry to be given demonstrations of what the Department of Agriculture is doing in immunizing swine from hog cholera. Representatives from only a few States are invited to each conference, so that the demonstrations can be given to but a few at a time, which is of greater benefit to those present than one crowded meeting would be.

At the meeting attended by the writer there were present, beside the Chief of the United States Bureau of Animal Industry, Dr. Melvin, the chief of the biochemic division, Dr. Dorset; Dr. Niles, in charge of the experiment station, and his assistants; two veterinarians from the Canadian Department of Agriculture; the State veterinarian of Illinois; the State veterinarian of Montana; the veterinarian of the State Experiment Station of Wyoming, and the bacteriologist of the Delaware Department of Agriculture.

The results that have been accomplished by the government in immunizing swine from hog cholera are most valuable and interesting. It has been found that swine can be successfully immunized, and also that it is practicable to do so. This is done by using serum from the blood of a hyperimmunized hog, and virulent blood from a pig having hog cholera in an acute form. About 20 cubic centimeters of the serum is injected with a hypodermic syringe inside the thigh of the pig to be immunized, and 2 cubic centimeters of virulent blood serum inside the other thigh, and the combination of serum and virulent blood seems to give the pig to be pro-

tected immunity from the disease.[1] This principle of combining an active virus and a serum at the same time was first adopted by Koch in immunizing cattle from rinderpest in South Africa.

A recent adaptation of the same principle is one for protecting from rabies dogs that have been bitten by rabid dogs. The material is obtained from the Pasteur Institute in New York and costs $20 per dog. The dog is given the first injection under the skin in the region of the flanks, as soon as possible after being bitten, and in about two weeks the second injection is given, a more powerful material being used the second time. If the dog remains free from rabies for two or three weeks after the second injection he will not develop the disease, and also has an immunity from rabies conferred upon him which, it is claimed, will last for a year and a half or longer. This immunity is conferred in much the same way as the immunity from hog cholera; that is, serum from a hyperimmunized sheep is mixed with a certain amount of fresh brain from a rabid rabbit, and used first in a mild strength and later in a much stronger mixture. This treatment has not yet been tried on humans; persons bitten still have to take the usual Pasteur protective treatment. It has not been used upon other animals than dogs, because horses and cattle would take so much that the expense would be almost prohibitive.

Iowa, it is said, has about 7,000,000 swine and Illinois about 5,000,000. In such States this method of immunization would be most valuable, and ought to be taken up by the State live stock sanitary boards. In Massachusetts there are only about 85,000 swine and only a few large herds, most of them being kept by persons who own but a few animals; and considering the amount of hog cholera occurring in this State it is a question whether or not it would be worth while for the Commonwealth to establish a small farm and laboratory for

[1] Any one interested in a full and detailed account of the work done at the experiment farm of the United States Department of Agriculture at Ames, Ia., is referred to Bulletin 102 of the Bureau of Animal Industry, United States Department of Agriculture, which may be obtained by writing to the Secretary of the United States Department of Agriculture, Washington, D.C., or to his own congressman.

this work. It might be worth while to have such a plant to do this, combined with other work, either at the State Experiment Station at Amherst or at some more available location near Boston. At present all the heads from dogs and other animals to be examined for rabies, swabs to be inoculated into guinea pigs for diagnosing glanders and the like, sent to the Cattle Bureau office are forwarded to the Harvard Medical School for examination. With a laboratory as suggested above work could be done on hog cholera, making the diagnoses that are now made at the Harvard Medical School, preparing material for the preventive inoculation against symptomatic anthrax, and perhaps making mallein and tuberculin.

While the Governor has authority to send delegates to a conference or convention as cited above, he cannot authorize any one to incur any expense on the part of the Commonwealth beyond its boundaries if sent to investigate any matter.

For example, November 10 a telegram was received from Dr. Leonard Pearson, State veterinarian of Pennsylvania, from Milton in that State, announcing an outbreak of foot-and-mouth disease. It seemed at the time that it was important and desirable to send an agent of the Massachusetts Cattle Bureau at once to the scene of the trouble in order to ascertain its extent and origin, and to see if there was any danger of its extending to Massachusetts. This was suggested to the Governor, who referred the Chief of the Cattle Bureau to the Attorney-General to ascertain if an agent could be sent at the expense of the Commonwealth. After consulting the law the Attorney-General gave it as his opinion that such an expense could not legally be incurred.

It would seem that here there is a defect in the law that ought to be remedied, as there must be instances when it is more important to be able to send an agent to investigate and report upon some matter than it is to be able to send delegates to some conference or congress. In this case there was but one thing to do, and that was to wait patiently for what information could be gleaned from the newspapers and from correspondence with State officials in New York and Pennsylvania,

and the Chief of the United States Bureau of Animal Industry. As can well be imagined, these officials have been very busy, and in many instances it has taken time to obtain the information desired.

This outbreak of foot-and-mouth disease is interesting because it gives rise to the question, how can a disease that was not known to exist on this continent, but that would have to be imported from abroad, probably from Europe or Asia, suddenly make its appearance here, and at a point so remote from the seacoast?

When the outbreak of epizoötic aptha in Massachusetts occurred during the winter of 1902 and 1903, it was supposed at that time that it must have been brought here in hay or straw used for packing merchandise, thrown out upon the docks at East Boston and taken to Chelsea by some thrifty Hebrew cow owner, and that cattle thus infected started the outbreak. No other possible solution of the question would ever have been thought of if it had not been for the experiments of Dr. Ernest E. Tyzzer at his father's farm in Wakefield in the summer of 1903, a full account of which is given in the fourth semiannual report of the Chief of the Cattle Bureau to the State Board of Agriculture. Dr. Tyzzer was at that time making a study of smallpox, and his investigations included a study of vaccine virus. In making some inoculation experiments on calves he started an independent outbreak of foot-and-mouth disease at his father's farm. The United States Bureau of Animal Industry and the Massachusetts Cattle Bureau then hired a little place at Wakefield, and bought three cows and three calves and took them there. Dr. Tyzzer then repeated his experiments with the same vaccine virus, with the same results. The following is an extract from the report above referred to: —

It is perfectly evident, from the results of these experiments, that vaccine virus may become contaminated with the virus of foot-and-mouth disease, and convey the latter through the medium of animals used for the production of vaccine virus. This accidental discovery may be the solution of the cause of the original outbreak.

As nearly as can be ascertained, the first place for foot-and-mouth disease to make its appearance was upon the premises of the late

Owen Clark, in Prattsville, just over the Revere line, either late in July or early in August, 1902. By the latter part of August it had spread to the premises of two or three of his neighbors, and thence was carried to various points, where the disease prevailed during the autumn and winter of 1902 and 1903.

Prior to the time of the discovery and public announcement of foot-and-mouth disease, the middle of November, 1902, the New England Vaccine Company of Chelsea bought the young cattle it used for the production of vaccine virus from Mr. Clark, who would buy thrifty looking young cattle from various sources, and when they had been used at the New England Vaccine Company's establishment he would take them home to his place, where they were kept for a while, until he could dispose of them.

The proprietor of the New England Vaccine Company states that the vaccine virus produced there during the last three or four years has retained its strength to a remarkable degree, and that it has not been necessary to introduce new "seed," as is often done at these establishments when the virus is found to be deteriorating; but it has been his custom when inoculating animals to put in a couple of "control" points of virus placed on the market by other producers, in order to compare the quality of his with theirs, and to be sure that his product was maintaining its standard of strength as compared with others.

During 1902 he used the product of six different American manufacturers of vaccine virus, among others some from the same establishment from which Dr. Tyzzer's supply was obtained, which was used in the Wakefield experiments.

During the summer of 1902 the proprietor of the New England Vaccine Company was in Europe, and little was done at that establishment; but in order to keep the vaccine virus from losing its vitality it was necessary for his assistant to inoculate an animal every month or six weeks, for the purpose of carrying the supply along at a standard strength. When one of these inoculations was made, "control" points were also put in for comparison. It does not seem unlikely that a heifer may have been inoculated in July, and control points used which were contaminated with foot-and-mouth disease virus, enabling the animal to convey the disease to Owen Clark's premises either late in July or early in August, without contaminating the vaccine virus produced by the New England Vaccine Company, as it has been shown by Dr. Tyzzer's investigations that the calves inoculated with a mixed vaccine and foot-and-mouth disease virus did not show easily recognizable symptoms of foot-and-mouth disease, yet they were capable of producing it in an unmistakable form among the cattle with which they were kept. At least, there is no history to show that animals used later at the New Eng-

land Vaccine Company's establishment for the production of vaccine virus had any disease other than cow-pox.

. . . .

As foot-and-mouth disease prevails extensively in France, Italy, Austria and Switzerland, and also to a less degree in some of the other European countries, it does not seem impossible for the disease to have been imported from Europe in fresh "seed" brought over to some vaccine virus establishment in the United States, to renovate a product that was losing its vitality.

Having this possible origin in mind, and knowing that there was at Detroit, Mich., a large drug manufacturing firm that of late years has embarked extensively upon the production of biological products for the market, a letter was written to the Chief of the United States Bureau of Animal Industry, as follows: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Nov. 20, 1908.

Dr. A. D. MELVIN, *Chief United States Bureau Animal Industry, Washington, D. C.*

DEAR SIR: — When the time comes to trace the possible source of the outbreak of foot-and-mouth disease I think the possibility of its being introduced into this country through vaccine virus should not be lost sight of. At the time of the outbreak of foot-and-mouth disease in Massachusetts in the winter of 1902–03, an independent outbreak was started in Wakefield in August, 1903, by Dr. Ernest E. Tyzzer, who was doing some experimental work in the study of vaccine virus. He inoculated calves with vaccine virus obtained from a wholesale manufacturing drug firm of Philadelphia, at his father's farm, and started an independent outbreak of foot-and-mouth disease. The United States Bureau of Animal Industry and the State of Massachusetts afterwards had him repeat the experiments at a little place that was hired in Wakefield for the purpose, and he gave calves foot-and-mouth disease again with the same vaccine virus. Dr. Salmon always took the ground that it might have been contaminated by having been kept in Dr. Frothingham's ice chest at the Harvard Medical School, but this does not seem at all certain.

The original outbreak of foot-and-mouth disease in 1902 seems to have started in Chelsea, and one of the first places where it occurred was on the premises of a man named Owen Clark. Owen Clark used to furnish cattle to Dr. Culver, who ran a vaccine virus establishment in Chelsea. After Dr. Culver was through with the cattle he

used to return them to Clark. Dr. Culver from time to time obtained vaccine virus from outside sources to either strengthen his product or to standardize it. Among others he had material from the same firm in Philadelphia, in the summer of 1902.

I think it would be well in investigating this outbreak to see if the ——— Company in Detroit has had any vaccine virus from abroad recently, also find out whether they kill the cattle that they use for producing vaccine virus, or whether they are sold to farmers in the vicinity of Detroit. If it cannot be traced in this way to the ——— Company I think any other vaccine virus plant in any locality where foot-and-mouth disease seems to have originated ought to be investigated in the same way, in order to determine whether there is a possibility of the disease being introduced into this country through some such source or not.

If you do ascertain the origin of the trouble I would be very much obliged to you if you could give me a brief history of the trouble and its origin.

Yours respectfully,

AUSTIN PETERS,
Chief of Cattle Bureau.

The result has been that the outbreak in Pennsylvania was traced to the stock yards at East Buffalo, thence to the stock yards at Detroit, and from there to various herds nearby, and finally to the farm of the drug firm in question. The difference between the management of the young cattle used at the plant of the Philadelphia concern in 1902–03 and the Detroit firm is that the Philadelphia firm killed the calves when it was through with them, hence the disease did not escape in the neighborhood of Philadelphia in 1902 as it otherwise would, while the Detroit firm sends its young cattle to its farm after it is through with them, and from there the disease spread and has made a great deal of trouble. Both the firms in question are said to have had a virus from Japan which they considered particularly active. It is not unlikely that the malady has been imported each time in Japanese vaccine virus, and the present outbreak seems to prove conclusively that the outbreak of 1902–03 was brought here in precisely the same manner as the present one. The present outbreak appears to be well in hand, and there seems to be no danger of its extension to Massachusetts. The United States Department of Agriculture has forbidden shipments of neat cattle, swine, sheep or other ruminants from infected

States into other States, as well as hay, straw, hides, skins, hoofs, etc. The federal orders have been supplemented by Cattle Bureau orders concurring with them so as to still further protect this Commonwealth, and have also been extended to include grain and grain bags from the infected districts. As the situation has improved in New York State and Michigan, the orders have recently been modified to allow the shipments of hay, straw, grain, grain bags, hides, skins and hoofs from all but five counties in western New York and five counties near Detroit in Michigan. This has brought much-needed relief to the hay and straw market in Massachusetts, particularly Boston, which was feeling the effects of the embargo.

The quarantine regulations are still in force on cattle, swine, sheep and other ruminants in New York, Michigan, Pennsylvania and Maryland. The total number of animals killed thus far as diseased or exposed is 3,605, on 154 farms or premises. The total appraised value of these animals is $88,268, of which two-thirds has been or is to be paid by the federal government and one-third by the States. The figures for the different States are: Michigan, 9 premises, 242 cattle, 23 hogs, 9 sheep and 3 goats, value $5,359; New York, 45 premises, 520 cattle, 246 hogs, 214 sheep, value $24,378; Pennsylvania, 98 premises, 1,202 cattle, 999 hogs, 52 sheep, 4 goats, value $56,903; Maryland, 2 premises, 31 cattle, 60 hogs, value $1,628. The value of the animals and loss to the farmers is small compared with the commercial losses caused by closing the ports of New York, Philadelphia and Baltimore to shipments abroad of cattle and sheep, hay, straw, grain and the like, and the increase in the price of hay and straw to consumers in New England cities.

These outbreaks of foot-and-mouth disease emanating from commercial concerns are arguments in favor of State and government control in the manufacture of all biological products. While these establishments were making liquid soaps, or tincture of aconite or strychnine, they were producing products of little or no danger, except when poisonous drugs were prepared, and then there was no danger except to the individuals using them, but when these concerns turn their

attention to supplying the demand for biological products it is very much like a small boy playing with a buzz saw.

Diphtheria antitoxin, vaccine virus and similar products should be prepared only in State laboratories by men who put honor above dollars, and have something at stake in their reputation as scientists. Having foot-and-mouth disease escape from these commercial establishments twice within less than a decade has cost the country millions of dollars, to say nothing of the danger to human health from contaminated vaccine virus, and it is time a halt was called upon this system, and some method of controlling these disasters instituted.

Rabies.

During the year ending Nov. 30, 1908, rabies has continued to be very prevalent and troublesome, but has diminished somewhat from the preceding year.

The report for the year ending Nov. 30, 1907, showed that there were still in quarantine 209 dogs, 1 cow, 2 horses and a cat. Of these, 186 dogs, 2 horses and the cat were later released from quarantine, and the cow and 20 dogs were killed by the owners or died from some other cause than rabies, and 3 dogs developed this disease and either died of it or were killed.

The following table shows the extent to which the disease has prevailed, exclusive of Boston, during the past year: —

	Dogs.	Horses.	Cattle.	Swine.	Cats.	Goats.
Killed or died with rabies, . .	454	5	32	14	1	1
Killed by owners or died in quarantine, not rabid.	412	–	8	9	10	1
Reported as rabid, but found free from disease.	27	–	4	–	2	–
Released from quarantine, . .	402	4	3	1	2	–
Animals still in quarantine, . .	82	–	4	1	5	–
Totals, ...	1,377	9	51	25	20	2
Grand total, ...	1,484	–	–	–	–	–

In addition to the animals there have been at least 5, possibly 6, cases of rabies among humans, 2 in Boston, 1 in Newton, a little girl from Southbridge at the Worcester Hos-

pital and an old man in Bernardston. None of the persons infected supposed the dogs to have been rabid from which the infection was received, except the Bernardston man. He started to take the Pasteur treatment but changed it for Christian Science treatment, and died.

In addition to these animals a herd of swine was appraised and killed in Lexington, numbering 78 head, and paid for from the county dog fund after 9 had died of rabies as the result of a rabid dog entering the premises and biting a number of them. The 9 pigs that had rabies are included in the table; the others are not included in the figures there given.

The veterinarian of the Boston board of health reports 50 cases of rabies in dogs in that city during the year, making a total for the entire State of 504 mad dogs. The total number of dogs having rabies during the year ending Nov. 30, 1907, in Massachusetts, including Boston, was 741, showing a decrease of 237 cases.

The table given above also shows an improved state of affairs at the end of the year, as there were only 92 animals in quarantine Dec. 1, 1908, compared with 213 the corresponding date of 1907. It is hoped that this diminution will continue until the outbreak is over, when the malady will undoubtedly remain quiescent for a number of years, to reappear when another surplus of susceptible dogs has grown up; that is, it will do so if history repeats itself, and it is probable that it will.

During 1908 Dr. Frothingham has examined the brains of 166 animals for rabies, of which 135 have proved positive or probable cases and 31 have proved to be negative.

At the time of writing this report the situation seems to be better than for some time, and it is hoped that the outbreak is subsiding. There have not been any cases west of Worcester for a number of months, and very few cases north of Boston. The more recent troubles have been in Marlborough, Southborough, Hudson, Sudbury, Stow and Framingham, as one center. All these towns have issued orders to have dogs properly and securely muzzled or restrained from running at large, some of which expire Jan. 1 and some Feb. 1, 1909. The Framingham order expires about April 1. The

other locality where rabies exists is Boston, and some of the cities and towns to the south and west. Orders to keep dogs properly and securely muzzled or restrained from running at large have been issued by the cities and towns of Newton, Brookline, Watertown, Waltham, Weston, Wellesley, Needham, Milton and Quincy. There seems to be at last a decided intention on the part of the local authorities in most places to enforce these orders. The mayor and aldermen of Boston issued an order October 21 that dogs must be muzzled or restrained from running at large for three months, but for some reason it does not seem to have been enforced, and it appears to have been a miserable and lamentable farce. It is to be regretted that the principal city of the Commonwealth cannot enforce such an order in co-operation with the surrounding cities and towns. This is the second time in less than two years that the Chief of the Cattle Bureau has succeeded in prevailing upon the local authorities in cities and towns adjoining Boston to issue orders requiring dogs to be properly and securely muzzled or restrained from running at large when the mayor and aldermen of Boston have issued similar orders, simply to have the best results obtainable lost by the failure of the order in Boston to accomplish much of anything. A few of the better citizens obey the order by keeping their dogs on leash, or by providing suitable muzzles, others use the figure 8 strap unriveted, which is not an effective muzzle, while the lawless element in the community pays absolutely no attention to the order whatever.

The only other center of any importance just now is Salem, where it is hoped a muzzling order will be put in force.

At a recent conference of the Brookline selectmen, the chief of police of Brookline, the inspector of animals of the town, and the Chief of the Cattle Bureau, it was decided that the figure 8 strap arrangement could be made effective by fitting it to the dog's nose and having it riveted, but when it is not riveted it is not an effective muzzle. The wire and other forms of strap muzzle are more desirable. A riveted figure 8 strap muzzle tight enough to prevent a dog from biting would be a very uncomfortable hot weather muzzle.

One of the largest losses to dog owners during the past year

was the destruction of the pack of hounds owned by the Myopia Hunt Club, because of an outbreak of rabies. A firm and rational stand against this disease four years ago might have prevented its spread in a great measure, and perhaps saved the lives of these and hundreds of other dogs, beside other animals and a number of human beings.

Two particular cases are worthy of special mention. One is that of a dog in Ludlow that was always kept chained; he was bitten by a rabid dog in the autumn of 1907 and was quarantined for six months; at the end of this period his owner was sent a notice of release. Four days later, March 11, 1908, he developed rabies, broke his collar and ran away, and was killed after biting a number of other dogs.

The other case was that of a dog in Milton, released from quarantine July 15, after being confined for a number of months, bitten by a rabid dog in August, from which he developed rabies and was killed October 10. If it had not been known when he was bitten in August his trouble might have been ascribed to the first bite, and have been cited as another case with a long incubative period. When rabies is prevalent in the community is it not possible that many of the cases of long periods of incubation recorded may be cases where the animal has been bitten a second time, without any one being aware of it?

There do not seem to be any further suggestions or recommendations to make in connection with this disease that have not already been made in previous reports for the last three or four years.

Glanders.

More horses or mules died or were destroyed because of glanders and farcy in Massachusetts, including Boston, during the year ending Nov. 30, 1908, than during any other year of which there is any record.

During 1907, 711 cases of glanders are recorded, beside which there were 26 cases which had not been disposed of. Twenty-two of these were later released and 4 were killed as having glanders. Of these 4, 1 was entered on the 1908 records, and the other 3 should be added to the 711 1907 horses, making 714 in all, 308 of which were Boston cases.

For the year ending Nov. 30, 1908, 941 horses or mules died or were killed with glanders or farcy in Massachusetts, including Boston. At first glance this looks like a very material increase for the entire State, but an analysis of the figures does not show this to be the fact.

The veterinarian of the Boston board of health reports 389 cases for the city of Boston; then there were at least 30 horses killed in outside cities and towns shortly after being purchased in Boston, either at some of the fake sales stables or at some of the weekly auctions of second-hand horses, and these animals by rights should be credited to Boston. There were also 21 horses or ponies killed at Revere during the summer which cannot fairly be credited to Massachusetts, as they belonged to a Wild West show from Oklahoma, and were never allowed off the grounds upon which the exhibition was given during their stay in this Commonwealth. Adding the 389 reported by the veterinarian of the Boston board of health, the 30 that were killed in other cities or towns after being purchased in Boston and 21 from Oklahoma together makes 440 to be deducted from the total of 941, leaving only about 500 as rightfully to be credited to the State at large.

Previous to 1908 the highest number of cases of glanders or farcy recorded in Massachusetts was in 1903, when there were 860 cases, of which only 250 were reported by the veterinarian of the city of Boston, and 610 occurred outside. At that time the number of Boston cases was but about 29 per cent of the total, not adding horses that may have been bought in Boston to those reported by the veterinarian of the Boston board of health. Now, counting in horses killed soon after being bought in Boston with those reported by the veterinarian of the Boston board of health, over 46 per cent of the cases should be credited to Boston.

The total increase in the number of cases outside of Boston in the year ending Nov. 30, 1908, over the previous year, after deducting the Oklahoma horses, was 128, for which the increase in cities and towns in close proximity to Boston more than compensates, the combined increase in Everett, Chelsea, Somerville, Cambridge, Medford, Belmont, Watertown, Wal-

tham, Brookline, Newton, Needham, Hyde Park, Milton and Quincy being 140.

In addition to the cases from outside the jurisdiction of the Cattle Bureau to be credited to Boston and Oklahoma, there were a few cases from New Hampshire and 1 from Maine. The single case in Haverhill was shipped there from Maine, and 3 or 4 which were detected by the agent of the Cattle Bureau detailed to the Thursday auction in Lowell came from New Hampshire. One of the horses killed at Andover came from Manchester, N. H., was sold by a dealer in Lowell to a poor Swede in Andover, and gave glanders to the horse he was bought to mate, and both had to be killed.

The following table shows the distribution of glanders throughout the State, and the increase or decrease from the previous year in cities and towns where it occurred. It will be seen that the State is practically free from glanders west of a line drawn north and south through Worcester, as only 7 cases have been found west of there, 3 in East Longmeadow, 1 in Savoy, 1 in Orange, 1 in Holland and 1 in Sturbridge. The cases in East Longmeadow were all owned by one man, and the trouble was brought from Connecticut, and the 1 in Savoy traces to a North Adams dealer who had a case in his stable the previous year.

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Acton, ...	1	–	–	2	–	1
Andover, ...	1	4	5	1	4	–
Arlington, ...	1	1	2	1	1	–
Ashby, ...	1	–	–	–	–	1
Ashfield, ...	–	–	–	1	–	–
Ashland, ...	–	–	1	1	1	–
Attleborough, . . .	5	2	–	1	–	5

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Auburn,	1	–	–	1	–	1
Ayer,	–	–	–	3	–	–
Barnstable,	–	–	–	3	–	–
Bedford,	3	14	1	–	–	2
Belchertown,	–	1	–	1	–	–
Bellingham,	–	–	–	1	–	–
Belmont,	2	–	9	24	7	–
Berkley,	1	–	–	–	–	1
Berlin,	2	4	–	–	–	2
Beverly,	3	–	–	–	–	3
Billerica,	–	–	–	1	–	–
Blackstone,	5	1	–	–	–	5
Boston,	308	18	389	17	81	–
Boxborough,	–	–	–	1	–	–
Braintree,	1	–	2	–	1	–
Brimfield,	2	–	–	–	–	2
Brookline,	8	54	18	61	10	–
Cambridge,	48	68	72	8	24	–
Charlton,	1	1	–	1	–	1
Chelmsford,	2	1	–	–	–	2
Chelsea,	19	2	26	18	7	–
Chicopee,	–	–	–	1	–	–
Concord,	1	–	1	1	–	–
Conway,	–	1	–	1	–	–
Danvers,	–	–	2	3	2	–

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Dartmouth,	1	–	–	–	–	1
Dedham,	3	–	2	–	–	1
Deerfield,	1	2	–	1	–	1
Dennis,	–	–	–	1	–	–
Douglas,	–	–	–	1	–	–
Dover,	–	–	–	7	–	–
Dracut,	1	1	–	–	–	1
Dudley,	4	–	–	2	–	4
Duxbury,	–	–	1	2	1	–
Easton,	2	–	–	1	–	2
East Longmeadow,	–	–	3	–	3	–
Essex,	1	–	–	–	–	1
Everett,	4	2	20	15	16	–
Fairhaven,	–	–	1	–	1	–
Fall River,	6	12	22	27	16	–
Fitchburg,	1	–	1	3	–	–
Foxborough,	–	1	2	2	2	–
Framingham,	1	–	1	–	–	–
Franklin,	1	–	–	–	–	1
Gardner,	–	1	–	1	–	–
Georgetown,	1	–	–	–	–	1
Gloucester,	–	–	1	2	1	–
Grafton,	2	2	–	–	–	2
Hancock,	–	–	–	2	–	–
Hanson,	–	–	1	–	1	–

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Hampden, . . .	–	–	–	1	–	–
Harwich, . . .	1	–	–	1	–	1
Haverhill, . . .	6	3	1	2	–	5
Hingham, . . .	1	–	5	26	4	–
Holden, . . .	1	–	1	2	–	–
Holland, . . .	–	–	1	–	1	–
Holliston, . . .	–	–	1	–	1	–
Holyoke, . . .	–	–	–	1	–	–
Hopkinton, . . .	1	–	–	1	–	1
Hudson, . . .	1	–	–	–	–	1
Hyde Park, . . .	1	–	15	24	14	–
Lancaster, . . .	–	–	2	4	2	–
Lawrence, . . .	5	2	10	7	5	–
Leicester, . . .	–	–	3	–	3	–
Leominster, . .	–	–	–	1	–	–
Lexington, . . .	1	–	5	–	4	–
Lowell, . . .	15	4	26	79	11	–
Lynn, ...	22	17	12	6	–	10
Lynnfield, . . .	–	1	–	1	–	–
Malden, . . .	5	3	5	1	–	–
Marblehead, . .	–	–	–	1	–	–
Marlborough, . .	–	1	2	1	2	–
Medfield, . . .	1	–	–	2	–	1
Medford, . . .	3	–	8	1	5	–
Medway, . . .	–	–	–	1	–	–

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Melrose, . . .	1	–	1	1	–	–
Methuen, . . .	2	1	2	–	–	–
Milford, . . .	2	–	–	2	–	2
Millbury, . . .	1	–	1	–	–	–
Milton, . . .	4	4	9	41	5	–
Montague, . . .	–	–	–	1	–	–
Needham, . . .	2	–	6	–	4	–
New Bedford, . .	5	–	11	5	6	–
Newton, . . .	12	1	27	51	15	–
North Adams, . .	1	–	–	–	–	1
North Attleborough, .	9	2	1	1	–	8
Northborough, . .	–	–	–	1	–	–
Norfolk, . . .	3	–	–	–	–	3
Norton, . . .	2	–	1	–	–	1
Norwell, . . .	–	–	1	–	1	–
Norwood, . . .	–	1	2	1	2	–
Orange, . . .	–	–	1	–	1	–
Oxford, . . .	1	1	1	1	–	–
Palmer, . . .	–	–	–	1	–	–
Paxton, . . .	–	–	–	1	–	–
Peabody, . . .	3	–	4	1	1	–
Plymouth, . . .	–	1	1	1	1	–
Princeton, . . .	1	1	–	–	–	1
Quincy, . . .	7	4	8	12	1	–
Randolph, . . .	–	–	4	10	4	–

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Reading,	9	–	2	–	–	7
Rehoboth,	3	–	3	–	–	–
Revere,	6	29	24	54	18	–
Rochester,	–	2	1	1	1	–
Royalston,	3	5	–	–	–	3
Salem,	1	2	3	–	2	–
Saugus,	1	–	5	1	4	–
Savoy,	–	–	1	–	1	–
Scituate,	–	–	2	–	2	–
Seekonk,	2	–	1	–	–	1
Shrewsbury,	5	13	–	–	–	5
Somerville,	33	49	58	68	25	–
Southampton,	–	–	–	1	–	–
Southborough,	1	–	–	1	–	1
Southbridge,	–	–	1	–	1	–
Southwick,	–	–	–	1	–	–
Springfield,	–	3	–	2	–	–
Stoneham,	1	–	3	2	2	–
Stoughton,	–	1	–	2	–	–
Sturbridge,	1	–	–	–	–	1
Sudbury,	–	–	1	–	1	–
Swampscott,	1	3	–	–	–	1
Taunton,	–	–	3	–	3	–
Townsend,	–	–	–	1	–	–
Wakefield,	4	1	3	2	–	1

CITY OR TOWN.	1907.		1908.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Walpole, . . .	1	–	1	2	–	–
Waltham, . . .	2	–	7	4	5	–
Watertown, . .	5	1	7	14	2	–
Webster, . . .	–	–	4	10	4	–
Wellesley, . . .	1	–	2	1	1	–
Wenham, . . .	1	–	–	1	–	1
Westborough, . .	1	–	–	–	–	1
West Boylston, . .	1	–	1	–	–	–
Westfield, . . .	–	–	–	1	–	–
Westminster, . .	3	1	–	–	–	3
Weston, . . .	1	1	1	–	–	–
Westport, . . .	–	–	3	1	3	–
West Springfield, . .	–	–	–	1	–	–
Westwood, . . .	1	10	1	1	–	–
Weymouth, . . .	9	4	6	28	–	3
Whitman, . . .	–	–	1	1	1	–
Winchendon, . .	1	1	–	1	–	1
Winchester, . .	–	–	2	13	2	–
Winthrop, . . .	5	10	4	3	–	1
Woburn, . . .	2	–	3	1	1	–
Worcester, . . .	40	20	26	3	–	14
Wrentham, . . .	–	1	–	1	–	–
Yarmouth, . . .	–	–	–	1	–	–
Totals, . . .	711	463	941	737	–	–

The above table shows 941 cases of glanders and farcy, and 737 animals released. There are also 22 horses that have not been released, as they are in stables where mallein tests are being carried on and they have not yet ceased to react, making a total of 1,700 horses and mules on the Cattle Bureau books for 1908, the considerable number released being due to the large amount of mallein testing done.

The decrease in Worcester is very gratifying, as a few years ago about 100 horses a year were killed or died there with glanders. There was a milkman's stable in Shrewsbury where there used to be glanders, and every little while a horse with the disease was killed there. A couple of years ago the horses in this stable were all mallein tested, and those that reacted were retested once a month until they ceased to react or showed physical evidence of disease and were killed. These horses were used for peddling milk in Worcester, and were evidently the cause of some of the trouble, as after this place was cleaned up the disease has decreased steadily ever since in that city.

The table shows an increase in Lowell of 11 cases, but 7 of these were reported by the agent of the Cattle Bureau who has been employed for the last year to inspect the horses sent to the Thursday auction, and were brought from out of town, therefore the real increase over the previous year has been but 4 cases.

During the year several cases have been prosecuted, the offences being for breaking quarantine, removing a horse to prevent its being inspected and disobeying an order of the Chief of the Cattle Bureau, in all of which convictions have been secured in the lower courts. Two appealed cases in Middlesex County have been settled in the higher court, one appealed case in Norfolk County remains undisposed of as yet, and an appealed case from the Lawrence police court, from October, 1907, still remains unsettled.

The reports of the renderers, which they are required to make from week to week under the provisions of section 111 of chapter 75, Revised Laws, as amended by chapter 243, Acts of 1907, are of a great deal of value, as a number of cases of glanders are reported by them every year which are

reported in no other way, and when a case is heard of in this way an agent is sent to see that the stable is properly disinfected, and if there are other horses in the stable they are inspected either by the local inspector of animals or an agent of the Cattle Bureau, provided, of course, that the case is within the jurisdiction of the Chief of the Cattle Bureau.

The renderers' reports are tabulated below: —

Reports of Rendering Companies.

Rendering Companies.	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not previously reported.
The Butchers' Rendering Company, Fall River.	3	–	–	–	–
Fitchburg Rendering Company, . .	1	1	–	1	–
William S. Higgins, Saugus, . .	5	6	–	6	3
The Home Soap Company, Millbury, .	1	–	–	–	–
Lowell Rendering Company, . .	17	5	–	5	–
E. W. Munroe, Rockland, . . .	2	–	–	–	–
James E. McGovern, Andover, . .	17	15	–	15	2
Muller Brothers, North Cambridge, .	36	95	7	88	7
W. H. Nankervis, Marlborough, . .	5	2	–	2	1
New Bedford Extractor Company, .	10	10	–	10	4
New England Rendering Company, Brighton.	48	152	41	111	34
Peabody Tallow Company, Peabody, .	10	6	–	6	–
N. Roy & Son, South Attleborough, .	6	5	–	5	2
Whitman & Pratt Rendering Company, North Chelmsford.	26	14	–	14	1
Worcester Rendering Company, Auburn,	16	21	–	21	7
N. Ward Company, Boston, . .	53	345	263	82	6
Totals, ...	256	677	311	366	67

During the year more mallein testing has been done than in any previous year. There have been fifty stable tests. In many stables horses had been killed with glanders, and then the stable tests were inaugurated with a view to eradicating the disease. It will be seen by the following table that 75 horses with glanders or farcy were killed before making a test, that 609 were tested, of which 341 were released on the first test, 120 on the second test, 86 on subsequent tests, and that 39 were killed after the first or subsequent tests.

Stable Tests with Mallein.

City or Town.	Number killed before making Test.	Number in Stable, First Test.	Released on First Test.	Released on Second Test.	Released on Subsequent Tests.	Killed after First or Subsequent Tests.	Months covered by Tests.	Largest Number of Tests.	Held for Further Tests.
Belmont, ...	3	23	17	5	–	1[1]	1	2	–
Braintree, ...	–	9	6	–	–	1	–	–	2
Brookline, ...	2	58	40	10	2	6	7	6	–
Brookline, ...	1	3	3	–	–	–	–	1	–
Chelsea, ...	2	20	–	15	1	–	4	3	4
Dover, ...	1	7	3	2	2	–	2½	3	–
Dudley, ...	–	2	–	–	2	–	4½	5	–
Everett, ...	1	13	9	–	2	–	6	5	2
Fall River, ...	2	4	2	–	1	1	6	6	–
Fall River, ...	1	1	–	1[2]	–	–	2	2	–
Fall River, ...	–	1	1	–	–	–	–	1	–
Fall River, ...	1	2	–	2	–	–	2	2	–
Fall River, ...	–	6	5	–	1[3]	–	–	2	–
Fall River, ...	3	13	–	11	–	–	–	–	2
Hingham, ...	1	6	2	1	2	1	5	4	–
Hingham, ...	1	20	16	4	–	–	2	3	–
Hyde Park, ...	5	26	15	5	4	2	3	4	–
Lowell, ...	1	2	–	2	–	–	1½	2	–
Lowell, ...	4	72	39	17	13	2	5½	5	1
Lawrence, ...	1	5	4	–	1	–	5	4	–
Lancaster, ...	–	3	3	–	–	–	–	1	–
Lynn, ...	1	2	1	–	–	1	–	1	–
Milton, ...	2	36	19	8	9	–	5	4	–
Milton, ...	2	3	3	–	–	–	–	1	–
Milton, ...	1	2	2	–	–	–	–	1	–
Newton, ...	1	8	7	–	–	1	–	1	–
Newton, ...	1	3	1	–	1	1	8	6	–
Newton, ...	1	6	3	2	–	1	2	2	–
Newton, ...	1	8	5	–	3	–	7½	6	–
Newton, ...	2	24	11	7	4	2	5	4	–
Newton, ...	1	2	1	–	–	–	–	–	1
Quincy, ...	2	5	3	1	1	–	4	4	–
Quincy, ...	1	3	2	–	1	–	3	4	–

[1] Killed by owner, no lesions found. [2] Killed later. [3] Died of colic.

Stable Tests with Mallein — Concluded.

City or Town.	Number killed before making Test.	Number in Stable, First Test.	Released on First Test.	Released on Second Test.	Released on Subsequent Tests.	Killed after First or Subsequent Tests.	Months covered by Tests.	Largest Number of Tests.	Held for Further Tests.
Quincy,	1	3	3	–	–	–	–	1	–
Revere,	9	60	29	1	16	14[1]	4	5	–
Randolph,	2	5	3	–	–	–	–	–	2
Somerville,	–[2]	31	16	10	5[3]	–	4	4	–
Somerville,	1	11	2	5	2	2	2½	3	–
Somerville,	3	1	–	–	1	–	7	6	–
Somerville,	2	21	12	4	5	–	6	6	–
Somerville,	2	10	4	–	–	1	–	–	5
Stoneham,	1	1	1[4]	–	–	–	–	1	–
Webster,	1	8	8	–	–	–	–	1	–
Webster,	1	2	2	–	–	–	–	1	–
Weymouth,	2	8	7	–	1	–	5½	5	–
Weymouth,	1	18	18	–	–	–	–	1	–
Watertown,	1	12	12	–	–	–	–	1	–
Winchester,	1	18	–	7	6	1	4	4	4
Winthrop,	1	1	1	–	–	–	–	1	–
Worcester,	–	1	–	–	–	1	6½	5	–
50 stables,	75	609	341	120	86	39	–	–	23

[1] No lesions in two.
[2] Horses from infected stable put in here.
[3] Three of the horses released contracted glanders later and were killed.
[4] Died after first test.

One of the most interesting tests was that at Revere, as these animals belonged to a Wild West Show from Oklahoma, which was giving exhibitions at Revere Beach during the summer. Glanders was discovered among these animals just before Decoration Day and 9 were killed at once. The remaining animals, 52 in all, were tested with mallein and 31 reacted. Later 8 new purchases were tested, none of which reacted. There were two stables on the grounds where the exhibition was given, and the animals were separated, the non-reactors being put in one barn, the reactors in the other, and were kept apart as well as circumstances permitted. One

reactor was released on a second test and 16 were released on subsequent tests. Fourteen reactors were killed, of which 2 showed no lesions of disease on autopsy and were paid for by the State on a valuation of $100 each.

The interesting feature of the case was that the proprietor of the show wished to leave the State toward the end of September with the animals that remained apparently healthy, and after writing to the Bureau of Animal Industry at Washington about the case a reply was received saying that animals that reacted to mallein could not be shipped out of Massachusetts. As a number were still reacting, this left the Chief of the Cattle Bureau with the choice of releasing them from quarantine, or killing them and having the Commonwealth reimburse the owner for the value of the animals in which no lesions could be found. The Chief of the Cattle Bureau could not allow them to be disposed of and undertake to keep track of these animals after the show broke up, as he occupied the peculiar position of a State official without authority over the whole State. After careful deliberation the following letter was written: —

[U–71.]

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Aug. 25, 1908.

Dr. A. D. MELVIN, *Chief United States Bureau Animal Industry, Washington, D. C.*

SIR: — Your letter of August 21 duly received, relative to the horses and ponies in the Wild West Show at Wonderland, Revere.

I find I wrote you promptly May 29 last relative to the outbreak of glanders in the stock at Wonderland. I have had the animals that have shown physical evidence of disease killed, and have kept the others under observation in quarantine since then, with the exception of half a dozen Shetland ponies which he has disposed of, only one of which ever reacted to mallein, and these were disposed of through a misunderstanding.

Inasmuch as these animals came from Oklahoma, and seem to be only in transit through the State as a part of an itinerant show, and inasmuch as the owner is not a resident of Massachusetts, but is simply here with his exhibition, it seems to me a case where the United States Bureau of Animal Industry ought to step in and take charge of the matter. The reacting animals and those that have not

reacted are still at Wonderland, and the owner is anxious to leave the State the 20th of September, and is desirous of taking his stock away with him, and wishes to stop in Virginia and Ohio on the way home and give exhibitions in those States before returning to Oklahoma. If he were a resident of Massachusetts, and had a permanent stable here, I should test his entire lot of horses, as I have already done, separate those that reacted from those that gave no reaction, and test them once a month until they ceased to react, or until they showed some physical evidence of glanders and I ordered them killed.

I do not like the idea of ordering the reacting horses that he has here killed, and having to pay for those in which no satisfactory lesions of glanders could be detected out of the appropriation of the Cattle Bureau. At the same time, if he could not take them away with him from this State and wanted to sell them, I fear they might go into stables where I would have no control over them, particularly as I do not have jurisdiction over the entire State of Massachusetts; but if any of these animals were taken into the city of Boston they would be entirely beyond my control, as much as if they were taken to Oklahoma. If, therefore, there is any way for the Bureau of Animal Industry to send an agent here to investigate this outbreak, and determine what is best to be done in the matter, I would like very much to put the whole affair in your hands.

Hoping to hear from you at as early a date as possible, I remain

Yours respectfully, AUSTIN PETERS,

Chief of Cattle Bureau.

As a result of this correspondence the Chief of the United States Bureau of Animal Industry arranged to send an agent to test the animals that had reacted at the end of September, with the understanding that any that did not react to his test could be removed by the owner, and that the State of Massachusetts would kill the reactors. An agent of the United States Bureau of Animal Industry was sent from Washington the end of September to test the animals about which there was any question. He tested 22, of which 18 gave no reaction and were released, and 4 reacted and were killed by the State authority; lesions were found in 3; none could be found in 1 and the Commonwealth paid for it. Thus what at one time seemed to be a rather complicated state of affairs was cleared up. It seems to be another argument in favor of one general law for the State, and a repeal of the special legislation enacted a few years ago to

please the Boston board of health by putting glanders and farcy and rabies under its control, when already a competent agency existed for the control of these diseases, supported by ample law, and stronger laws than the city board of health has to sustain it.

For the past year an agent of the Cattle Bureau has been present at the horse auction in Lowell and examined all the horses offered there at the weekly sales, with the result that 7 cases of glanders have been discovered and killed before going on to do further mischief. Some of these animals had recently passed through the auction sales stables in Boston, others killed at other places outside of Boston during the year were purchased at auction in Boston, yet the Chief of the Cattle Bureau has absolutely no authority to employ an agent to inspect horses offered for sale in Boston, although many of them go to outside cities and towns. He has no authority to trace the history of a glandered horse after he traces it to a sales stable in Boston, or any power to investigate, and if he finds that the seller knew or had reasonable cause to believe that a horse had glanders, he has no right to prosecute him for selling such an animal. He has no right to prosecute any one for removing a glandered horse from Boston to another city or town, or to prosecute any one for breaking quarantine by removing a quarantined horse from Boston to another city or town. There is something more to the suppression of glanders than the authority to kill an animal because it has glanders or farcy, and it would seem that the changes made in the law in 1897 and 1899 should never have been made. To show how soon glanders develops in some of the cheap class of horse sent to these sales, it is interesting to note that 2 horses found to be glandered at the Lowell auction sales had been sold there two or three weeks before, and at that time passed inspection.

There was quite a discussion before the committee on agriculture of the Legislature last winter as to whether the State should or should not pay for glandered horses. A change in the law to provide payment in a limited sum was favored by the Expressmen's League and some stable keepers and horse owners, and evidence produced to show that this

is done in some States, and that some good authorities think that paying something for animals of this kind is a help in eradicating the disease, but the committee was of the opinion that a glandered horse had no value, and that it was therefore not necessary to change the law.

Dr. Langdon Frothingham has continued to do the laboratory work in connection with glanders, as for the past ten or twelve years.

Annual Inspection of Neat Cattle, Farm Animals and Premises upon which the Former are kept.

Late in September the following circular letter was sent to the inspectors of animals in the cities and towns of the State, together with the necessary books in which to record the results of their work, and blank forms of certificates of health to be given owners in conformance with section 18, chapter 90 of the Revised Laws: —

Commonwealth of Massachusetts,
Cattle Bureau of the State Board of Agriculture,
Room 138, State House, Boston, Sept. 15, 1908.

Directions to Inspectors of Animals.

Inspectors of animals are hereby directed to make a general inspection of the neat stock in their respective towns, and incidentally other farm animals, to commence October 1 and to be completed before the fifteenth day of November, as required by chapter 90 of the Revised Laws.

Wherever inspectors examine animals and find them free from contagious disease they will give owners certificates of health, as provided for in section 18 of the law, from the book of blanks (Form No. 2) furnished for that purpose. Books will also be provided (Form No. 1) for carrying out the provisions of sections 17 and 24 of chapter 90 of the Revised Laws.

Inspectors will not say on any report, "Same as last year," but will make a full and complete report on every place inspected, including all dimensions and measurements provided for on the blank, and answer in full all questions as to the light, ventilation, sanitary surroundings and water supply, as well as the number of cattle kept in each stable, and give a complete list of other animals in spaces provided in the book.

Inspectors of animals are not to quarantine any cattle as tuberculous unless they show sufficient evidence of disease to make it

possible to condemn them on a physical examination, or show evidence of tuberculosis of the udder.

It is also requested that, if cases of tuberculosis in animals are found, inspectors keep a record of them for a few days, and then when animals are quarantined several can be quarantined at once, and duplicates sent here, so that the agent of the Cattle Bureau can see a number at one visit, instead of having to go every two or three days to see one animal at a time, thus avoiding running up expenses as much as possible.

It is also the duty of inspectors of animals to quarantine cattle brought into this State from without the limits of the Commonwealth if the owner has not had a permit from this Bureau, the same to remain in quarantine until ordered released by the Chief of the Cattle Bureau or his agent.

Inspectors of animals, in case they suspect the presence of any contagious disease among any species of domestic animals, are to quarantine such animals and send duplicates to the Chief of the Cattle Bureau.

Contagious diseases, under the provisions of section 28, chapter 90 of the Revised Laws, include glanders, farcy, contagious pleuropneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

The necessary books for the inspection will be forwarded at once. Please report immediately if not received by October 1. When inspection is completed return book, Form No. 1, at once by express.

AUSTIN PETERS,
Chief of Cattle Bureau.

The following table embodies a condensed report of the doings of the inspectors of animals in making the annual inspection, which complies with the requirements of section 24, chapter 90, Revised Laws: —

Report of Inspection of Animals, Stables, etc., required by Section 24, Chapter 90, Revised Laws.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Abington,	100	320	287	91	–	72	–	106	93 [1]	36 [1]	17 [1]	86 [1]	103 [1]	3
Acton,	105	1,113	881	93 [1]	6	117	–	117	112 [1]	97	116	112	109	58
Acushnet,	119	567	459	91 [1]	–	160	–	121	119	73 [1]	94 [1]	102	111	3
Adams,	84	1,058	800	71 [1]	104	599	–	80	66	50	64	77 [1]	77 [1]	2
Agawam,	187	1,515	1,116	179 [1]	6	546	–	205	179	186	194	198	200 [1]	18
Alford,	41	344	284	36 [1]	199	101	–	44	26	35 [1]	44	43	44	–
Amesbury,	97	544	408	90	33	118	2	97	82	95	93 [1]	93	97	1
Amherst,	132	1,710	1,386	127 [1]	6	287	–	141	135	125	129	141	141	14
Andover,	164	1,309	1,003	161	18	460	–	178	175	148	175	172	177	3
Arlington,	62	149	140	62	–	83	1	62	53 [1]	56	50	57	62	2
Ashburnham,	119	618	403	90 [1]	39	195	3	120	107	81	97	104	87	2
Ashby,	133	778	578	84 [1]	170	102	–	136	54	92	118	90 [1]	134 [1]	3
Ashfield,	156	1,362	833	141	775	262	91	175	146	147	152	164	163	1
Ashland,	81	382	313	75	–	115	–	82	78	64	68	73	67	4

[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Athol,	138	729	506	127	35	210	–	139	121	66	104	130	126	3
Attleborough,	153	1,032	909	146[1]	1	702	–	152	141	144	148[1]	146	152	2
Auburn,	89	622	518	59[1]	15	73	1	78	71	69[1]	77	72[1]	74[1]	19
Avon,	60	221	207	44[1]	8	72	3	61	25	25	46	53[1]	59[1]	3
Ayer,	17	125	91	22[1]	–	69	–	26	23	21	20[1]	21	23	1
Barnstable,	228	629	456	–	38	417	3	230	210	226	226	224	224	–
Barre,	76	1,772	1,208	76	39	198	15	85	82	75	81	79	83	19
Becket,	71	465	254	71	276	94	59	72	55	67	72	72	72	–
Bedford,	58	569	467	55[1]	–	2,752	2	58	29[1]	56	42[1]	54[1]	58	4
Belchertown,	281	2,042	1,613	266	42	495	5	308	268	248	307	294	308	15
Bellingham,	98	642	498	86	–	122	–	119	111	65	108	106[1]	119	2
Belmont,	31	228	215	31	–	250	–	31	28	23	25	30	13[1]	1
Berkley,	112	427	369	111	25	138	1	112	113	112	112	112	112	1
Berlin,	95	717	560	89[1]	50	68	–	101	37	84	98	99	101	3
Bernardston,	59	664	421	52[1]	173	121	–	60	59[1]	38	39	55	54	–
Beverly,	66	508	449	62[1]	–	56	–	65	61[1]	56	64	62	62[1]	5

Billerica,	119	819	618	115	2	496	5	119	114	115	109	111	119	–
Blackstone,	72	439	365	67	–	117	–	72	69	45	44	64	55	3
Blandford,	113	870	532	105[1]	303	153	–	127	95	113	122	125	124	5
Bolton,	85	683	561	30[1]	12	1	4	84	30[1]	62[1]	60[1]	69[1]	5[1]	1
Boston,	195	899	852	186	143	202	–	203	8	6	7	170	–[1]	–
Bourne,	74	161	146	7[1]	–	17	–	74	71[1]	74	74	73[1]	74	–
Boxborough,	47	627	369	46	19	61	49	48	47	46	48	48	45	8
Boxford,	75	595	454	62[1]	16	129	–	77	76	59	67	75	77	2
Boylston,	61	697	510	59	1	259	2	63	21	61[1]	63	63	62[1]	3
Braintree,	99	479	449	93[1]	–	137	–	101	90	97	97	93	101	4
Brewster,	79	165	111	79	15	66	2	80	61	78	80	72	80	–
Bridgewater,	175	717	560	161[1]	31	884	4	173[1]	157[1]	161[1]	159[1]	156[1]	166[1]	1
Brimfield,	110	1,004	714	98[1]	41	122	2	110	92	53	91[1]	110	109	–
Brockton,	81	983	780	76[1]	8	615	7	91	78	81[1]	70[1]	74[1]	89[1]	–
Brookfield,	118	875	580	95[1]	28	236	–	120	108[1]	96	23[1]	100[1]	113[1]	6
Brookline,	36	178	145	30[1]	26	52	12	38	33	32	29	31	38	–
Buckland,	130	851	572	96[1]	526	223	1	145	134	80	25[1]	121[1]	144	1
Burlington,	49	445	393	44[1]	1	2,678	3	49	48	47	49	48	49	–
Cambridge,	19	108	105	19	–	–	–	22	20	21	21	21	22	–
Canton,	119	547	456	117	–	128	43	119	110	117	118	119	119	–
Carlisle,	63	576	495	60	–	29	–	69	67	47	46	52	67	–
Carver,	84	195	136	79	15	76	1	83	78	82	82	80	78	1

[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Charlemont,	128	888	552	34[1]	554	332	–	139[1]	120	136[1]	137[1]	138[1]	136[1]	1
Charlton,	141	1,725	1,167	138	57	217	–	148	144[1]	143	133	131	93[1]	4
Chatham,	73	144	123	70[1]	–	100	3	75	70	65	71	73	69	4
Chelmsford,	87	889	742	81[1]	1	107	–	110	110	91	105	107	110	10
Chelsea,	29	211	206	26	–	85	–	35	32	29	29	26	29	2
Cheshire,	122	1,410	994	111[1]	54	388	2	109	92[1]	100	108	109	93	21
Chester,	80	545	282	79	293	130	12	102	85	52[1]	99[1]	98[1]	102	–
Chesterfield,	96	821	444	92	3	176	1	119	90	75	110	113	115[1]	4
Chicopee,	86	528	411	77[1]	–	368	–	86	74	70[1]	77[1]	79[1]	77[1]	3
Chilmark,	53	269	118	52[1]	2,054	17	–	50	48	34	50	49[1]	49	1
Clarksburg,	84	420	291	83[1]	–	232	4	85	73	82	85	85	85	1
Clinton,	45	91	76	45	1	67	2	45	42	36	38	44	45	1
Cohasset,	108	262	209	41[1]	–	87	–	109	86	52	20	26	37	10
Colrain,	187	1,717	956	85	1,364	563	3	201	175	82	184	99	201	2
Concord,	148	1,550	1,275	140[1]	–	591	–	157	152	153	154	156	155	–
Conway,	90	1,368	949	–[1]	694	164	–	82	69[1]	73	76	75	43[1]	–

Cummington,	89	793	508	83[1]	85	128	7	106	72[1]	70	92	95	105	1
Dalton,	29	679	484	29	56	154	-	41	28	40	41	41	41	-
Dana,	67	327	209	67	9	71	-	72	72	43	72	72	72	2
Danvers,	68	927	875	68	-	4	-	73	69[1]	73	73	73	73	-
Dartmouth,	194	1,933	1,696	180	70	486	6	205	196	169	145	188	189	32
Dedham,	97	589	545	79[1]	-	410	-	101	75	87[1]	85[1]	84	92	3
Deerfield,	120	1,054	781	107[1]	3	288	-	123	104[1]	54	116	118	97[1]	8
Dennis,	107	211	155	88[1]	-	242	-	102	88[1]	95	92[1]	99[1]	100[1]	11
Dighton,	106	479	365	105	27	93	2	119	114	118	116	119	118	-
Douglas,	102	366	271	72[1]	-	155	-	101	74	51	92	73	97[1]	-
Dover,	49	416	366	29	32	181	-	50	43	48	44	50	48	1
Dracut,	72	1,056	932	69	-	401	-	73	71	69	69	73	73	1
Dudley,	119	1,042	866	49[1]	-	142	-	112	94[1]	60[1]	52[1]	47[1]	62[1]	11
Dunstable,	63	556	405	57	17	171	-	71	70	60	71	70	65	4
Duxbury,	118	342	268	113[1]	18	56	-	117	102[1]	103	107	109	111[1]	-
East Bridgewater,	171	735	596	142[1]	4	380	9	191	67	122	148	165	185	24
Eastham,	52	128	87	49[1]	-	66	-	52	44[1]	34	32	48	41	-
Easthampton,	89	845	641	84[1]	-	232	-	97	72	97	97	96[1]	97	-
East Longmeadow,	66	600	479	64	4	123	-	66	56	43	65	63	66	-
Easton,	156	804	653	152[1]	5	22	-	182	169	179	179	179	182	-
Edgartown,	58	268	204	58	786	204	3	65	65	63	64	61	64	7
Egremont,	95	908	728	95	138	108	9	98	60	98	98	96	95	7

[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Enfield,	79	482	355	77[1]	103	167	3	80	74	62	79	79	80	2
Erving,	46	167	115	45	1	64	-	43	35	41	43	43	43	4
Essex,	75	552	409	74[1]	34	53	-	76[1]	73[1]	73[1]	74[1]	75[1]	75	1
Everett,	46	186	181	37[1]	-	-	-	49	44	39	35	42	49	2
Fairhaven,	61	512	414	61	-	125	-	62	59	60	62	61	62	-
Fall River,	90	617	561	80[1]	1	20	1	91	89	55	56[1]	67	91	3
Falmouth,	160	443	351	152[1]	1	239	1	160	133	117[1]	133[1]	150	158	7
Fitchburg,	157	948	724	140	1	200	5	168	108	50	43	88	115	4
Florida,	64	455	276	21	7	143	1	71	54	28	8	27	71	3
Foxborough,	133	471	364	130	7	250	1	143	132	143	143	138	143	6
Framingham,	193	1,546	1,265	194[1]	12	549	100	216	196	212	215	214	213[1]	-
Franklin,	146	796	664	135[1]	-	154	1	145[1]	139	136	141[1]	141	143	4
Freetown,	104	297	214	94	20	87	1	108	96	79	97	99	74	8
Gardner,	66	729	552	63[1]	13	193	-	70	62	49	51	67	70	5
Gay Head,	24	85	23	24	-	12	1	24	21	2	2	24	24	-
Georgetown,	76	316	216	74	33	52	6	77	45	67[1]	73[1]	68[1]	76	7

Gill,	74	846	529	42[1]	235	215	–	75	72	48	66[1]	58	73	2
Gloucester,	103	610	567	93	–	94	–	105	99	64	59	66	31[1]	20
Goshen,	46	378	188	33[1]	60	132	–	36[1]	31	26	34	27[1]	29[1]	–
Gosnold,	6	38	26	6	1,500	38	–	7	7	6	7	6	7	–
Grafton,	103	1,387	1,080	58[1]	116	364	2	108	97	61	16	45	105[1]	17
Granby,	118	1,326	1,137	118	50	158	1	135	135	123	135	133	134	2
Granville,	91	470	303	90	3	128	–	95	85	87	95	94	94	5
Great Barrington,	120	1,705	1,148	104[1]	49	621	–	145	89[1]	87	89[1]	103	133[1]	5
Greenfield,	123	1,471	1,084	28[1]	1,289	439	–	122	117[1]	55	92[1]	41[1]	121	–
Greenwich,	69	368	299	64	–	72	–	73	70	57	72	69	72	46
Groton,	131	932	617	99[1]	86	126	–	136	130	102	122	102	99	9
Groveland,	69	345	262	62[1]	35	105	–	72	68[1]	53	65	57[1]	72	1
Hadley,	205	1,762	1,171	169[1]	126	620	–	272	238	188	240[1]	245[1]	259[1]	2
Halifax,	66	167	120	65[1]	–	34	–	66	31	66	65[1]	64	66	–
Hamilton,	49	284	229	43	–	117	–	55	51	38	46	45	55	6
Hampden,	83	689	453	82	1	107	–	87	80	86	87	86	87	1
Hancock,	59	635	415	47	565	104	–	98	68	71	85	79	97	11
Hanover,	119	284	250	115[1]	18	165	4	117	108[1]	117	117	115	117	3
Hanson,	92	217	188	87	–	142	4	92	89	91	92	88[1]	83	5
Hardwick,	121	2,393	1,639	117[1]	230	338	–	134	132[1]	83	131	112[1]	134	1
Harvard,	134	1,489	1,086	78[1]	7	10	–	146	143	118	143	104	132[1]	8
Harwich,	102	236	172	93[1]	1	75	2	102[1]	52[1]	81[1]	91	101	102	4

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Hatfield,	130	368	338	125	–	218	–	130	127	130	130	130	130	1
Haverhill,	296	1,341	1,183	291	45	671	20	297	233	274	270	292	295	47
Hawley,	78	688	451	65[1]	214	115	–	93	85[1]	64	84[1]	91	89[1]	4
Heath,	84	835	455	80[1]	413	112	–	94	69	92	93	92	93	2
Hingham,	149	605	494	145[1]	25	270	–	155	133	144	145	154	155	1
Hinsdale,	92	840	540	83	33	123	6	92	53	60	65	90[1]	92	1
Holbrook,	70	227	187	22[1]	–	107	–	70	38	58	64[1]	64	67	1
Holden,	134	849	601	70[1]	–	187	1	139	128[1]	85	93[1]	45[1]	107[1]	10
Holland,	31	200	96	31	63	47	–	34	29	19	34	32	32	–
Holliston,	141	825	593	136	6	141	–	141	127[1]	108	73	95	140	7
Holyoke,	82	747	571	80	–	131	1	82	57[1]	68	69	82	82	–
Hopedale,	26	102	81	15[1]	–	42	1	26	24	25	25	23	26	–
Hopkinton,	135	640	473	67[1]	–	194	–	136	134[1]	71	71	71	126[1]	1
Hubbardston,	102	883	601	100	20	179	80	100	57	99	99	100	100	–
Hudson,	39	270	206	34[1]	–	122	–	39	37	31	31	33	34[1]	2
Hull,	16	56	47	15	–	32	–	16	12	5[1]	4[1]	14	–[1]	–

Huntington,	93	658	364	84[1]	245	152	–	100	75	84	100	94	80	4
Hyde Park,	17	91	86	15	–	–	–	20	20	13	11	19	18	–
Ipswich,	124	804	680	123[1]	15	178	5	127	122[1]	127	126[1]	123[1]	125[1]	2
Kingston,	95	271	215	64[1]	18	103	2	97	86	64	50[1]	51	97	8
Lakeville,	98	367	267	80	1	133	1	98	96	78	96	73	97[1]	1
Lancaster,	67	641	509	47[1]	16	133	–	68	64	43	63	56	55	2
Lanesborough,	61	976	737	60	11	218	–	74	51	56	66	72	74	20
Lawrence,	8	112	87	8	1	20	1	8	7	7	7	7	8	–
Lee,	169	821	607	160[1]	237	326	22	173	136[1]	167	171[1]	173	133	–
Leicester,	55	549	469	54	–	80	–	57	54	57	57	57	55	6
Lenox,	28	484	367	27[1]	–	29	–	28	18	23	23	28	27[1]	11
Leominster,	107	1,163	833	42	12	133	–	122	114	84	88	62	96	–
Leverett,	105	631	427	96[1]	23	186	–	112	102	86	111	109	97	7
Lexington,	75	1,049	968	65	3	483	15	75	73	52	56	67	50[1]	1
Leyden,	75	620	343	75	458	161	–	81	61	70	80	79	81	2
Lincoln,	84	937	846	68[1]	3	678	–	84	77[1]	51	61	48	48[1]	2
Littleton,	81	1,362	1,041	79[1]	–	77	–	81	80	80	81	81	78	–
Longmeadow,	48	253	216	–[1]	–	106	–	52	37	42[1]	46[1]	51[1]	52	–
Lowell,	41	360	333	38	3	555	–	41	35	28	31	37	39	2
Ludlow,	124	759	680	126	22	233	–	131	108	92	127	125	103	7
Lunenburg,	136	1,143	805	128	17	262	4	140	136	115	135	132	139	1
Lynn,	74	284	274	49	–	171	2	75	73	49	58	45	75	4

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Report of Inspection of Animals, Stables, etc. — *Continued.*

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Lynnfield,	27	320	289	25[1]	-	51	-	27	26	27	26	27	26[1]	-
Malden,	40	244	244	21[1]	-	-	-	46	45	27[1]	21[1]	28[1]	45[1]	-
Manchester,	19	92	79	19	-	43	5	20	18	20	20	20	20	-
Mansfield,	119	407	316	100[1]	-	231	6	123	114	100	112	106[1]	112	4
Marblehead,	52	343	294	51	-	254	3	51	44	25	33	44	13	19
Marion,	38	150	122	33	-	169	1	38	36	26[1]	25[1]	26[1]	37[1]	-
Marlborough,	196	1,176	913	176	34	616	5	204	192	174	183	189	202	13
Marshfield,	143	456	333	141[1]	8	348	6	149	136	127	137[1]	140[1]	149	-
Mashpee,	18	27	16	18	-	28	-	18	16	11	18	16	18	1
Mattapoisett,	86	320	229	79	-	171	4	87	82	74	79	81	85	4
Maynard,	27	143	112	22	-	172	-	27	23	26	26	25	26	3
Medfield,	68	556	422	68	-	369	-	74	72	73	73	72	74	1
Medford,	66	526	500	65	1	22	5	76	70	56	53	75	76	-
Medway,	118	526	403	102[1]	-	45	-	118	115	101[1]	104[1]	106[1]	116	3
Melrose,	26	102	95	15	-	-	-	26	22	15	12	11	26	-
Mendon,	86	540	425	70	-	147	-	97	97	54	60	74	95	8

Merrimac,	56	345	256	45[1]	-	90	-	58	51[1]	46	8	46	58	1
Methuen,	169	1,481	1,301	77	1	742	12	173	164	74	52	66	172	-
Middleborough,	302	826	640	292	11	479	12	303	292	297	300	301	302	3
Middlefield,	50	509	221	46	286	162	3	53	40	39	53	50	53	3
Middleton,	53	376	317	44[1]	2	407	21	53	52	50	49[1]	52	53	-
Milford,	131	409	359	127	2	232	5	131	122	109	105	100	129	5
Millbury,	134	1,007	818	123	2	260	21	148	126	134	134	136	144	8
Millis,	73	673	507	33[1]	16	67	-	74	72	34	27	40	61[1]	5
Milton,	106	764	720	106	92	127	-	110	99	108	108	110	110	1
Monroe,	25	168	96	25	54	50	-	25	23	24	25	24	25	2
Monson,	198	1,576	1,073	181[1]	5	678	19	246	222	169	212	203[1]	239[1]	6
Montague,	145	893	524	102[1]	15	328	-	153	143	80	72	116	136	6
Monterey,	74	560	391	71[1]	154	82	-	87	46[1]	71[1]	79[1]	83	86	3
Montgomery,	34	307	235	34	42	20	-	35	28	35	35	35	35	1
Mount Washington,	15	88	62	14	6	73	-	16	10[1]	7	15	15	16	-
Nahant,	6	9	9	6	-	-	-	6	6	5[1]	6	6	6	-
Nantucket,	53	448	344	53	131	81	6	53	51	49	53	53	53	3
Natick,	96	518	431	80	-	92	-	98	87	29	25	54	96	1
Needham,	93	588	528	73[1]	12	283	-	97	79	44	80	80[1]	82[1]	-
New Ashford,	21	161	107	18	239	46	3	27	21	27	27	27	26	1
New Bedford,	60	449	408	55	-	28	-	60	53	55	52	57	58	1
New Braintree,	73	1,521	1,181	73	2	79	-	73	73	67	69	71	72	1

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Newbury,	117	1,425	1,035	102[1]	82	275	1	173	157[1]	128	166	172	146	1
Newburyport,	89	487	374	83[1]	30	227	–	103	99	98	101	93	93[1]	6
New Marlborough,	142	1,427	976	139[1]	305	176	–	168	124[1]	126	146[1]	140	165[1]	5
New Salem,	109	463	314	99	59	79	–	109	104	109	109	102	109	1
Newton,	216	1,200	1,112	166[1]	20	246	5	238	177[1]	189[1]	185[1]	187[1]	222[1]	4
Norfolk,	73	446	340	67[1]	–	246	–	72	71[1]	69	69	69	59	5
North Adams,	31	489	402	31	–	122	–	31	27[1]	31	31	31	31	–
Northampton,	62	792	531	58[1]	–	237	–	66	48	50	66	65	66	8
North Andover,	65	953	718	59	8	71	–	65	61	63	63	63	65	3
North Attleborough,	89	612	498	76[1]	4	120	–	90	82	84	81[1]	89	76	25
Northborough,	125	1,046	832	114	33	49	–	130	127	103	76	110	73	13
Northbridge,	85	574	403	81[1]	4	188	–	95	89	84	86	74	95	3
North Brookfield,	144	1,240	920	94[1]	–	131	–	161	151[1]	31	38[1]	123[1]	157[1]	12
Northfield,	73	627	474	67[1]	68	118	2	73	68	57	62	64	73	2
North Reading,	61	571	444	56	5	10	–	63	58	55	63	54	63	1
Norton,	160	505	397	143[1]	28	203	1	159	144[1]	146[1]	131[1]	147[1]	155[1]	4

Norwell,	98	228	184	95	22	274	-	98	93	68	97	97	98	-
Norwood,	98	454	381	84[1]	-	138	-	102	88	65[1]	62[1]	89[1]	101[1]	-
Oak Bluffs,	39	152	121	38[1]	9	99	-	39	39	36[1]	38	39	35	3
Oakham,	51	610	455	44	-	58	-	51	49	30	25[1]	46	34[1]	9
Orange,	170	1,051	734	164	49	315	-	184	168	156	163	171	184	2
Orleans,	75	136	118	65[1]	-	58	-	70	57[1]	54	47	39	57	-
Otis,	91	441	262	87[1]	137	115	-	99	74[1]	99	99	99	99	1
Oxford,	149	909	616	135[1]	56	413	5	156	145	113	127	129[1]	155	2
Palmer,	178	907	701	168	-	66	-	189	158	102	115	165	167	2
Paxton,	58	520	393	55	4	47	-	57	55	38	49	54	55	-
Peabody,	40	672	641	39	77	372	-	39	7	38	39	35	39	1
Pelham,	45	167	134	43	-	56	-	44	39	33	37	43	44	2
Pembroke,	101	218	140	99	1	77	-	101	96	99	100	96	94	-
Pepperell,	135	846	723	122	-	196	-	150	146[1]	139	140	145	150	31
Peru,	47	385	233	46[1]	103	55	3	47[1]	37[1]	47[1]	47[1]	47[1]	43[1]	8
Petersham,	111	749	471	92[1]	179	189	2	109	104	48	46	82	102	2
Phillipston,	66	351	301	61[1]	-	126	-	71	64[1]	40[1]	69[1]	63[1]	69[1]	9
Pittsfield,	59	884	681	55[1]	29	67	1	56[1]	53	36	31	49	56	1
Plainfield,	64	600	354	54[1]	246	150	-	79	68[1]	48	64[1]	72[1]	70[1]	1
Plainville,	60	288	211	55	-	69	-	61	59	50	53	51	61	3
Plymouth,	171	472	377	144[1]	25	380	4	163	127	86	111[1]	128	162	14
Plympton,	55	221	151	50[1]	1	56	6	58	54	47	28	49	34	-

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Prescott,	67	484	321	34	-	106	-	67	64	43	66	60	67	5
Princeton,	107	1,216	833	88[1]	72	161	2	113	105	86	70	92	113	5
Provincetown,	12	87	71	11	-	14	-	13	12	9	6	9	9	4
Quincy,	70	649	619	58[1]	5	56	-	84	74	74	81	74	80	1
Randolph,	97	364	337	96[1]	-	418	1	98	92	98	98	98	98	6
Raynham,	119	603	472	117	13	207	-	120	115	87	107	115	119	6
Reading,	82	432	353	76	1	465	-	84	81	67	73	77	84	2
Rehoboth,	205	1,433	1,200	150[1]	36	468	-	206	194	117	118	135	205	3
Revere,	28	180	174	28	-	620	-	30	28	26	18	28	11	1
Richmond,	83	568	396	83	488	204	-	83	66	76	83	83	83	3
Rochester,	111	324	229	100[1]	13	257	3	114	114	67	99[1]	91	114	9
Rockland,	101	254	219	58[1]	-	55	-	103	97	64	48	56	102[1]	1
Rockport,	48	227	206	39	-	34	-	43	42	33	32	33	35	5
Rowe,	62	398	226	56	153	79	-	64	59	59	56	58	50	-
Rowley,	78	618	448	39[1]	18	62	5	79	38	50[1]	50[1]	47	63	4
Royalston,	113	702	448	87[1]	83	211	1	112	108	83	108[1]	94	111	2

Russell,	43	211	135	41	91	89	-	49	34	27	34	43	44	2
Rutland,	108	1,050	676	93[1]	1	240	4	127[1]	125	94[1]	124[1]	109[1]	126	21
Salem,	10	231	209	10	4	153	-	10	10	5	5	9[1]	10	2
Salisbury,	90	473	334	90	-	81	-	90	90	89	89	90	89	-
Sandisfield,	96	798	465	91[1]	31	167	-	110	82	71	110	103	102	1
Sandwich,	83	272	206	81[1]	-	87	1	83	75	82	82	83	83	-
Saugus,	38	840	823	33[1]	-	229	7	52	50	46	48	50	52	1
Savoy,	89	606	396	74	60	170	-	96	81[1]	33[1]	45[1]	87	87	1
Scituate,	130	399	286	126[1]	4	129	2	130	114[1]	119	129	122	130	3
Seekonk,	135	1,039	932	127[1]	22	2,825	61	148	134[1]	94	136	131	83[1]	10
Sharon,	72	318	272	71	1	156	-	75	64	61	75	73	54[1]	5
Sheffield,	194	2,145	1,466	164[1]	229	544	1	227	154[1]	124[1]	181[1]	198	180	33
Shelburne,	105	1,442	842	91[1]	877	131	-	106	90[1]	99	104	104	105[1]	3
Sherborn,	108	878	686	101	-	346	22	116	105	69[1]	56[1]	106[1]	110[1]	3
Shirley,	63	313	239	62	6	71	3	66	63	64	65	66	66	-
Shrewsbury,	125	1,382	1,043	120[1]	-	476	1	104	106	98	102	100	104	-
Shutesbury,	48	170	114	44[1]	2	76	1	54	49	44	54	53	49	3
Somerset,	81	607	525	74[1]	1	183	-	84	73[1]	82[1]	83[1]	82[1]	81[1]	2
Somerville,	28	77	71	24	-	193	2	29	28	15	15	24	29	2
Southampton,	142	1,112	806	140	43	344	-	148	123	141	140	146	145	6
Southborough,	94	1,111	948	77[1]	-	52	-	104	104	99	96[1]	97	103[1]	1
Southbridge,	77	643	471	71	-	195	-	81	79	73	76	72	80	2

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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South Hadley,	102	1,110	955	68	1	339	4	122	108	85	40	102	107	3
Southwick,	111	901	652	106[1]	366	263	26	114	103	89	105	111	111	-
Spencer,	128	1,377	967	121[1]	15	327	7	133	128	130	132	124	133	2
Springfield,	123	506	407	82[1]	20	1,294	7	85	57[1]	45[1]	68	72[1]	72[1]	-
Sterling,	144	1,726	1,286	126[1]	106	167	1	146[1]	137	98[1]	56[1]	122[1]	127[1]	7
Stockbridge,	93	853	620	73	424	215	5	109	75	48[1]	58	92	96	17
Stoneham,	74	393	342	42	2	945	-	83	31[1]	32	22	60	60	3
Stoughton,	137	465	387	98[1]	-	102	9	141	127	96	128	116	138	1
Stow,	95	908	636	14[1]	-	185	18	110	102[1]	40	27	23[1]	90[1]	4
Sturbridge,	56	692	416	44[1]	7	77	-	58	55	37	52	45	56	1
Sudbury,	72	1,134	931	62	-	289	2	78	23	68	68	76	75	1
Sunderland,	60	740	610	12	58	399	-	62	62	16	28	23	52	14
Sutton,	179	1,459	1,016	97[1]	59	254	3	193	185[1]	57[1]	18	97[1]	191[1]	22
Swampscott,	21	60	58	20	-	12	-	21	13	19	18	18	21	2
Swansea,	124	937	817	120[1]	3	162	-	124	123	124	124	123	124	1
Taunton,	149	896	751	146[1]	10	548	-	149	140	149	149	149	148	-

Templeton,	132	750	442	125[1]	5	237	-	135	129[1]	91[1]	113[1]	126[1]	134[1]	11
Tewksbury,	110	739	639	98	-	450	-	117	114	93	105[1]	91	105	1
Tisbury,	18	68	55	17[1]	-	40	-	18	17	16[1]	15[1]	17[1]	17[1]	5
Tolland,	34	409	255	34	-	98	-	46	35[1]	44	46	46	46	-
Topsfield,	72	567	473	62[1]	4	155	3	73	68[1]	56	59	58	63[1]	2
Townsend,	126	425	335	115	2	132	-	130	129	108	119	119	121	5
Truro,	55	204	164	54	-	60	-	55	41	55	55	55	55	1
Tyngsborough,	66	396	322	61[1]	83	361	-	63	60	54	58	63	61	4
Tyringham,	50	551	369	42	200	118	-	74	74	60	74	70	74	5
Upton,	80	505	350	74	-	125	-	85	74	74	79	75	85	-
Uxbridge,	121	826	590	117[1]	55	326	50	131	125	124	126[1]	128	124	4
Wakefield,	68	345	310	68	2	329	1	76	69	72	74	67	72	-
Wales,	46	244	148	45	131	95	-	50	44	37	46	48	30	3
Walpole,	95	513	423	95	26	520	1	95	66	70	73	72	81	5
Waltham,	28	513	469	15[1]	-	680	-	23	19[1]	15[1]	15[1]	17[1]	6	2
Ware,	108	977	687	107	-	153	8	108	105	102	108	106	108	4
Wareham,	86	255	209	74[1]	3	126	1	86	82	70	82	77	86	-
Warren,	132	1,727	1,153	116	39	240	1	146[1]	134	75	25[1]	127	125[1]	12
Warwick,	61	280	181	60	22	84	-	63	53	57	55	55	50	-
Washington,	52	638	329	35[1]	638	139	2	67	45	37	67	67	67	1
Watertown,	45	329	321	43	-	291	3	51	47	27	38	48	51	-
Wayland,	68	679	613	68	4	876	1	69	38	67	67	69	64[1]	2

[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Concluded.*

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Webster,	29	236	216	29	–	31	–	29	29	27	27	27	23[1]	3
Wellesley,	65	245	222	64	–	–	1	66	60	33	54	63	66	–
Wellfleet,	37	94	76	16[1]	–	49	–	37	31[1]	35	33[1]	36	37	4
Wendell,	63	214	121	56[1]	42	196	1	64	64	46	13	64	60	2
Wenham,	31	207	191	30[1]	–	3	–	31	30	31	31	31	27[1]	–
Westborough,	126	1,493	1,124	117	1	569	6	131	108	98	109	95	115	9
West Boylston,	88	916	695	85[1]	16	224	–	104	104	95	104	102	104	14
West Bridgewater,	82	717	609	70[1]	13	133	–	82	72	40[1]	61[1]	50[1]	39	14
West Brookfield,	97	1,393	819	83	22	277	10	111	108	20	44	80	95	10
Westfield,	228	1,412	1,000	225	8	666	3	249	219	248	248	248	248	2
Westford,	104	1,044	771	90	–	182	–	115	115	99	109[1]	82	115	2
Westhampton,	57	546	346	44	1	131	–	65	36	32	43	48	63	2
Westminster,	109	677	551	95[1]	27	1	–	102	96[1]	53[1]	6[1]	92[1]	1[1]	5
West Newbury,	116	1,021	785	110	58	289	5	127	65	118	125	100[1]	124[1]	112
Weston,	113	1,006	912	106[1]	55	421	–	119	110	109	112	105	119	15
Westport,	301	1,530	1,241	281[1]	11	414	1	311[1]	292	165[1]	248[1]	269[1]	286[1]	95

West Springfield,	129	879	715	127	6	513	–	129	123	128	125	127	129	10
West Stockbridge,	114	528	398	109[1]	18	170	1	109	83	104[1]	108	105	109	4
West Tisbury,	56	211	167	53[1]	897	54	–	53	25[1]	52	52	50	49	–
Westwood,	145	745	642	127[1]	3	339	1	152	143	136	148	141	152	1
Weymouth,	189	652	590	137	4	223	–	189	161	123	115	110	166	3
Whately,	104	734	515	104	15	275	–	121	113[1]	109	120[1]	119[1]	121	1
Whitman,	107	379	216	102[1]	5	259	6	84	75	65[1]	66	79[1]	84	8
Wilbraham,	113	835	502	88	–	248	–	132	110	102	119	94	117	4
Williamsburg,	103	688	436	89[1]	45	127	–	106	94[1]	55[1]	77[1]	97	90[1]	–
Williamstown,	184	1,470	1,136	160	1,494	556	2	184	161	106	83	158	184	8
Wilmington,	72	257	196	67	2	51	12	72	67	52	63	67	71	–
Winchendon,	126	743	550	125	16	246	5	123	110[1]	100	114	116	119[1]	23
Winchester,	36	244	235	35	2	106	6	38	27	32[1]	33	34	22[1]	1
Windsor,	87	791	493	87	98	193	–	108	84	105	108	108	97	1
Winthrop,	11	34	33	10	–	–	–	12	12	12	12	12	12	1
Woburn,	77	307	265	61	–	113	2	77	53	52	51	48	77	–
Worcester,	302	1,978	1,670	297[1]	62	3,845	2	303	290[1]	300	301	300	303	12
Worthington,	94	827	466	92[1]	118	181	–	97	76[1]	85	97	96[1]	96[1]	1
Wrentham,	66	262	201	33	–	67	5	66	64[1]	20	3	41	49	7
Yarmouth,	52	142	120	51	25	49	–	52	42	50	52	52	51	–
	33,011	234,347	177,047	28,395	26,384	82,801	1,185	34,666	29,999	26,630	28,484	30,280	32,035	1,732

[1] Incomplete report.

It will be seen by the foregoing table that the inspectors of animals examined 234,347 head of neat cattle, of which 177,047 were cows, as compared with 237,647 neat cattle the previous year, of which 155,876 were milch cows. The reason for the increase in the number of cows is that the year before the milch cows were given in one column; that is, those that were actually giving milk at the time of the inspection. As a good many cows that were milch cows when inspected will have become dry by the time the report is printed, and a good many of the cows that were dry will have calved, it seemed better to give in the table the total number of cows in the State, rather than the cows actually giving milk at the time of inspection.

The report shows an actual decrease in the number of neat cattle, compared with the previous year, of 3,300 head. The report of the inspectors of animals for the year ending Nov. 30, 1907, showed a decrease of nearly 10,000 head of neat cattle from the previous year, so that in two years there has been a decrease of over 13,000 head of neat cattle in Massachusetts, as shown by the reports of the inspectors.

Judging by the reports of the inspection by the inspectors of animals, there also seems to have been a slight falling off in the number of sheep and swine in the State, and a slight increase in the number of goats.

During the year 1908 the Legislature passed an act (chapter 378, Acts of 1908) providing that in all cities at least one of the inspectors of animals appointed under the provisions of section 12 of chapter 90 of the Revised Laws shall be a registered veterinary surgeon. This act was approved April 10, 1908. It means that hereafter a veterinary surgeon will have to be appointed as inspector of animals in a city. The reason this act was not made to include towns is because of the impossibility of securing veterinary surgeons to act as inspectors of animals in the small towns. While it may be desirable to have veterinarians in cities to fill these positions, it must be remembered that an inspector who is prompt and businesslike in his manner of doing his work, who attends immediately to orders directed to him by the Chief of the Cattle Bureau and makes his reports to the

office promptly, renders much more valuable assistance to the Bureau than even a veterinarian may do who is lax and unbusinesslike in his methods.

The Legislature also amended sections 11 and 27 of chapter 90 of the Revised Laws, relative to reports of contagious diseases being made to the Chief of the Cattle Bureau, so as to render the law effective, and has thus remedied the defects to which attention has been called in previous reports.

Tuberculosis.

At the International Congress on Tuberculosis, held at Washington during the past autumn, all kinds of views were presented by various scientists upon the danger to mankind from consuming the products of tuberculous cattle, Koch on the one hand saying that in taking measures for preventing the spread of tuberculosis in the human race the cow could be looked upon as a negligible factor, while on the other hand men like Dr. G. Simms Woodhead of the Royal British Commission, and Professor Arloing of Lyons, France, consider the use of the uncooked milk and other dairy products from tuberculous cows as very dangerous. The safest views to adopt are those of conservative men, such as Dr. Theobald Smith of Massachusetts, who believes there is a certain amount of danger from the use of raw milk from tuberculous cows, but that the danger has been in many instances exaggerated.

Dr. Smith was the first to discover a difference in the tubercle bacilli found in sputum and the type found in cattle. Koch speaks of them as the *typus humanus* and *typus bovinus* of the tubercle bacillus. Dr. Smith and his former assistant, Dr. P. A. Lewis, have investigated a number of cases of various kinds of tuberculosis, and in the cervical glands of children have found the *typus bovinus* in a number of instances. They have also been found in mesenteric glands, and may also occasionally be found associated with cases of tuberculous meningitis in children.

In about 50 per cent of the cases of tuberculosis of the cervical lymph glands studied by Dr. Smith and Dr. Lewis they found the bovine type of the tubercle bacillus present,

as shown by microscopic study and artificial cultivation. Other observers find from 25 per cent to 50 per cent of these forms of tuberculosis in children to show the bovine type of bacillus.

Last summer, in order to assist in this study, the Cattle Bureau bought six calves for experimental purposes and furnished their food and care. Dr. Smith and Dr. Lewis inoculated the calves with cultures of tubercle bacilli from the cervical lymph glands of three children suffering from this form of tuberculosis. Cultures from each case were inoculated intravenously into three calves and subcutaneously into three. All the calves developed acute and fatal tuberculosis, showing that the disease in the children was of bovine origin. The increasing numbers of cases of tuberculosis in swine seem to be of bovine origin. A case of tuberculosis in a horse, seen at Ayer by Dr. H. P. Rogers last summer, was due to infection from cattle, as Dr. Smith obtained a culture from the lesions in the horse's lung, where the bacillus was clearly of the bovine type.

The work of the inspectors of animals in quarantining tuberculous cattle and cows with nodulated udders, which are examined by agents of the Cattle Bureau and appraised and killed if found to be diseased, gives the State a fair system of dairy inspection as far as protecting the public health is concerned, but it is not decreasing the prevalence of the disease among our herds to any great extent, if at all. Tuberculosis is a disease that the farmer can no more afford to allow to prevail among his cattle and swine than he can afford to allow contagious pleuro-pneumonia or foot-and-mouth disease to run riot among his animals, and it is time the farmers of the State became more interested in its eradication than they are at present, from an economic point of view, even if the question of protecting the public health does not appeal to them. As the Cattle Bureau spends its entire annual appropriation, and more, too, every year, it does not seem possible to do any more than at present without having more money with which to work, yet if more could be done it would be desirable, and in the end might save money for the future.

There seem to be various ways in which more could be done if means permitted. If all cattle, except beeves for immediate slaughter and calves under six months old offered for sale at Brighton market each week, Massachusetts as well as out of the State cattle, could be tested with tuberculin, and the sale of all reactors stopped so as to furnish a clean market, thus preventing infected animals from going out into the herds of the Commonwealth, it would be an advance on our present methods. At present only dairy, working and store cattle from out of the State are tested, because the State would have to pay for Massachusetts cattle that reacted, and the funds of the Cattle Bureau are insufficient for this.

There are buyers from Hampshire and Franklin counties who buy Massachusetts cows that are farrow or a long way from calving and ship them up to Belchertown, Greenfield, Shelburne, Bernardston and such towns, where they are kept by different farmers until they come in again, and are then shipped to Brighton as fresh cows. Many of these animals are tuberculous, and are spreading disease wherever they go. Such creatures could not be shipped to Maine, New Hampshire or Vermont without having to undergo a tuberculin test. The movement of such animals should be stopped, intrastate as well as interstate. Then herds where tuberculosis is constantly being found should be tested, the premises disinfected by the State, the herd retested in three or four months, and if any reacted the premises should be disinfected again. The owner should be given to understand that he must purchase only tested animals in the future, and that the State would never again compensate him for a tuberculous creature. There are certain herds from which one or two cows are now taken by the State every year, and paid for by the Commonwealth, where it seems like putting a premium on disease to do so, as the owners would take more pains to keep their herds healthy if this market for diseased cattle were taken away.

At present, when an entire herd is tested by the State the test is made with the understanding that the owner will take what the butcher will give for reacting animals that pass slaughterhouse inspection as fit for beef, the State to pay for

those that have to be rendered. This puts part of the burden of expense on the owner, and deters many from asking for a herd test because they cannot afford it under the conditions named. If the law could be changed so that the State could allow the owner to take what the butcher paid for hides and carcasses, and the difference between this and the appraised value of the animals could be paid from the Cattle Bureau appropriation, it would permit of more work of this kind being done, and make the Cattle Bureau appropriation go farther. Under the present law, if the State agreed to have the owner reimbursed the full appraised value of his cattle, the total amount paid out would have to come out of the Cattle Bureau appropriation, and all money received has to go into the State treasury; this does not help the Cattle Bureau appropriation, and the public gives the Chief of the Cattle Bureau very little credit for what he turns in.

Even under the onerous conditions imposed there was more interest during the past year among owners in having their herds cleaned up than has been shown for several years. Thirty-five herds were tested, comprising 703 head of cattle, of which 556 passed the test and 145 were killed; of these, 41 were rendered; the rest passed for beef to the credit of the owner. Two pure-bred Holsteins are held for further observation. In 1907 16 herds were tested, comprising 454 animals, of which 300 were released and 152 killed, 26 of which were rendered. These figures show a gain in the interest taken, and also in the proportion of healthy cattle to diseased ones. One herd of 25 head in Shelburne was cleaned up several years ago, and when tested last summer there was not a single reaction. This farmer is a woman. Another herd at Gardner, owned by the State, contained 86 head of cattle, only 1 of which reacted.

Another method which may in time be perfected is one for immunizing healthy cattle against tuberculosis. If the 22,000 cattle brought into Massachusetts each year from other States, which are not released until they pass a tuberculin test, could only be immunized in some way at the same time that they are tested, before going out into the herds of the

Commonwealth, it would go a long way toward helping to solve the tuberculosis problem.

Another important matter to which Professor Bang of Copenhagen calls attention is the danger to calves and pigs fed on raw skim milk or buttermilk from co-operative creameries. All such milk should be pasteurized before allowing farmers to take it away. In Denmark this pasteurization is required by law, and the law also requires that the sediment and scrapings from separators be destroyed, and not fed to pigs at all, as was formerly customary. Bang recommends that similar legislation be enacted everywhere. In Denmark the law also requires that cream to be used for making butter for export shall be pasteurized.

The following figures show the number of cattle quarantined by the local inspectors, the number condemned, number released, etc.: —

Massachusetts Cattle.

Number released,	1,027	
Number condemned, killed and paid for,	1,187	
Number permit to kill, and paid for,	85	
Number permit to kill, no award,	375	
Number died in quarantine, no award,	68	
Number condemned and killed, in process of settlement,	577	
Number in quarantine, unsettled,	2	
Total Massachusetts cattle,		3,321

Cattle from without the State.

Number released,	21	
Number condemned and killed, no award,	374	
Number unsettled,	5	
Number condemned, killed, no lesions found, all of which have been paid for,	8	
Total number interstate cattle,		408
Total number of cattle quarantined or reported for examination during the year,		3,729

Of the above 408 interstate cattle, 239 were tested and retested at Brighton, 7 of which were released, 232 con-

demned, and no lesions were found in 2, for which the State has reimbursed the owners. Of the remaining 169 cattle (which were tested at other points than Brighton), 6 were found to show no lesions and paid for.

In addition to the 3,729 head of cattle disposed of as above, 496 cattle and 141 swine have been reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter. Of this number, 445 cattle and 117 swine were slaughtered at the Brighton Abattoir, and 278 cattle and 92 swine were but slightly affected and were passed by the inspector of the Boston board of health or the United States Bureau of Animal Industry inspectors as fit for food; the others were rendered.

The following table, compiled from the monthly reports sent by the Chief of the Cattle Bureau to the United States Department of Commerce and Labor, shows the animals received at Boston during the twelve months ending Nov. 30, 1908: —

Receipts of Live Stock at Boston for Twelve Months ending Nov. 30, 1908.

For Month ending —	Cattle.	Calves.	Sheep and Lambs.	Swine.	Horses.
Dec. 31,	21,592	11,348	55,382	124,786	1,270
Jan. 28,	15,569	7,594	26,901	157,654	950
Feb. 29,	17,458	7,834	26,307	143,848	2,275
Mar. 31,	16,880	13,892	22,526	128,331	3,050
Apr. 30,	15,232	13,028	16,847	82,826	3,450
May 26,	10,983	14,405	23,932	94,608	3,090
June 30,	15,344	15,842	33,673	145,914	2,456
July 28,	7,707	9,516	23,192	136,281	2,060
Aug. 25,	13,435	9,654	29,450	92,015	2,040
Sept. 29,	19,454	11,581	37,747	100,341	2,080
Oct. 27,	16,062	9,955	34,813	88,318	1,975
Nov. 28,	18,944	9,993	48,757	134,823	1,820
Totals,	188,660	134,642	379,527	1,429,745	26,516

Receipts of Stock at the Watertown Stock Yards, from Dec. 1, 1907, to Nov. 30, 1908.

Vermont cattle,	6,594
New Hampshire cattle,	4,324
New York cattle,	1,207
Massachusetts cattle,	2,262
Western cattle,	5,545
Sheep and lambs,	4,870
Swine,	4,932
Calves,	40,122

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, from Dec. 1, 1907, to Nov. 30, 1908.

Maine cattle,	58
New Hampshire cattle,	1,443
Vermont cattle,	6,043
Massachusetts cattle,	216
Western cattle,	62,885
Canada cattle,	11,335
Sheep and lambs,	353,123
Swine,	1,400,516
Calves,	44,648

Receipts of Stock at Brighton, from Dec. 1, 1907, to Nov. 30, 1908.

Maine cattle,	10,024
New Hampshire cattle,	1,978
Vermont cattle,	2,189
New York cattle,	3,135
Massachusetts cattle,	11,679
Western cattle,	50,893
Canada cattle,	6,894
Sheep and lambs,	22,535
Calves,	48,772
Swine,	34,297
Cattle tested,	14,651
Cattle condemned after test,	241
Cattle killed on permit to kill,	22
Cattle released after test,	14,388

Report of Cattle brought into State during the Year to Points Outside of the Quarantine Stations.

For dairy and breeding purposes, tested before shipment,	633
For dairy and breeding purposes, tested after arrival, .	5,906
For dairy and breeding purposes, awaiting test, . .	1
Total, ...	6,540
Neat cattle on which no test was required, exclusive of cattle and calves for immediate slaughter, . . .	1,135
Total, ...	7,675

The cattle and calves on which no test was required, exclusive of animals for immediate slaughter, were as follows: —

Returned from out of State pastures, ...	731
Calves under six months old, ...	400
Injured in transit and killed, or died before tested, . .	4
Total, ...	1,135

The number of cattle and calves brought into the State for immediate slaughter cannot be given exactly, as there were a number of permits issued on which definite returns were not received. In round numbers there were 8,000 cattle and calves brought in on permits intended for immediate slaughter.

Nearly all of the total number of animals given above were brought into the State on permits issued by the Chief of the Cattle Bureau, only 249 head having been brought in without permits, which were reported to this Bureau by railroad agents, local inspectors or others. Of these, 6 were accompanied by satisfactory certificates of tuberculin test, 1 was a calf under six months old, 19 were slaughtered at once for beef, 11 were simply unloaded in transit through the State, 2 were pastured in the State temporarily, and the remainder, 210 head, were tested by agents of the Cattle Bureau. There were also 2 herds brought into the State for exhibition without permit, which were duly reported to this Bureau.

There were 926 permits issued during the year. Of these, 128 were reported as not used, and 13 were revoked early in November on account of the existence of foot-and-mouth disease in other States.

Twelve permits were issued allowing cattle to be brought into the State for exhibition at agricultural fairs, to remain for a brief time only, 1 of which was not used; 7 were issued for returning cattle from exhibition in other States, and 1 permit was given allowing a six-legged calf to be brought in for exhibition purposes. Seventeen permits were issued for pasturing herds in the State during the season, and 3 allowing single animals to be brought in for a brief period, all the animals to be returned later in the season to the States from which they came. Two permits were given for returning cattle daily from pastures just beyond the State line. Six permits were given allowing cattle to be unloaded in transit through the State, and 1 allowing a number of head to be driven into the State to be loaded for shipment to the west.

Owing to the unsatisfactory work done by out of State veterinarians, Cattle Bureau Order No. 11 was amended by Cattle Bureau Order No. 15, which is as follows: —

CATTLE BUREAU ORDER NO. 15.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, April 29, 1908.

To Transportation Companies, the Brighton Stock Yards Company, and All Persons whom it may concern.

Cattle Bureau Order No. 11 is hereby amended so as to read as follows: —

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that tuberculosis, which is a contagious disease and is so recognized under the laws of this Commonwealth, exists among cattle of the several States and Territories of the United States, the District of Columbia and Canada, and such localities are, in the opinion of the Chief of this Bureau, infected districts.

You are hereby further notified that in order to prevent the importation of diseased animals, and as a means of suppressing this disease within this Commonwealth, the Chief of the Cattle Bureau hereby issues the following order: —

1. No neat cattle brought from any State or Territory of the United States, the District of Columbia, Canada or any other country without the limits of this Commonwealth shall be brought within the limits of this Commonwealth, except for delivery directly to the Union Stock Yards in the town of Watertown, the premises of the Brighton Stock Yards Company in Brighton, within the city of Boston, or the premises of the New England Dressed Meat and Wool Company in the city of Somerville, except upon a permit signed by the Chief of the Cattle Bureau, and no neat cattle so brought for delivery at any of said points shall be unloaded, except as provided in paragraph 3, at any point other than the said premises of the Brighton Stock Yards Company in Brighton, the Union Stock Yards in Watertown, or the premises of the New England Dressed Meat and Wool Company in Somerville.

2. All neat cattle brought within the limits of this Commonwealth from any place designated in paragraph 1 hereof, except for delivery as provided in the preceding paragraph, must be accompanied by a permit issued by the Chief of the Cattle Bureau.

3. If, for any cause, any such neat cattle are received by any of your agents within the limits of this Commonwealth at any place other than the Union Stock Yards in Watertown, the premises of the Brighton Stock Yards Company in Brighton, or the premises of the New England Dressed Meat and Wool Company in Somerville, not accompanied by a permit, as provided in paragraph 2 hereof, you will immediately notify this office, giving the place where said animals were received for shipment, the name of the consignee and destination of said animals. You will not remove said animals or permit them to be removed from the car or vehicle in which they are contained without permission from the Chief of the Cattle Bureau, or one of his agents, except that if, by reason of the crowded condition of the car, or because of the long confinement of said animals within the same, or for accident or otherwise, it is deemed expedient by you or your agent to unload the same, such animal or animals may be removed by you from said car or vehicle without permission, but in such case you will notify this office, and you will not allow said animal or animals to go out of the possession of your agent or off from your premises where said animals are unloaded except upon obtaining such permission.

4. All neat cattle brought within the limits of the premises in Brighton, Watertown and Somerville, designated in paragraph 1 hereof, are hereby declared to be quarantined until released by an agent of the Bureau.

5. All cattle except those for immediate slaughter, or calves under six months old, intended to be kept in the State permanently, must be tested with tuberculin by an agent of the Cattle Bureau after

arrival at destination, the only exception being cattle brought in from foreign countries which have passed a test given by an agent of the United States Bureau of Animal Industry. Cattle brought to the quarantine stations at Watertown, Brighton and Somerville, upon which a test is required, will be held and tested by the agent of the Cattle Bureau in charge of these stations. Cattle upon which a test is required, coming to points outside the limits of the quarantine stations, will be tested by an agent of the Cattle Bureau, free of expense to citizens of Massachusetts and at cost for other persons. All such cattle are to be held in quarantine at the risk and expense of the owner until released by order of the Chief of the Cattle Bureau. Cattle returning from out of the State pastures will not be subjected to a tuberculin test if they have not been out of the State over six months from the first of May previous. Cattle being sent out of the State during the winter months can be returned without being subjected to a tuberculin test within three months of the date of leaving the State. Animals under control of the United States Bureau of Animal Industry, Department of Agriculture, intended for export, are not included in this order. Animals believed to be diseased will be killed.

6. Any person violating the provisions of this order will be punished as provided in section 29 of chapter 90 of the Revised Laws.

7. Inspectors of animals throughout the Commonwealth shall publish this order by posting a printed copy of the same in at least three public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, May 6, 1908.

E. F. HAMLIN,
Executive Secretary.

Owing to the inconvenience and hardship caused certain individuals residing near the State line, who had cattle killed without appraisal or payment after bringing them into the State and having them react to tuberculin tests made by agents of the Cattle Bureau, Order No. 16 was issued to remedy this trouble. It reads as follows: —

Cattle Bureau Order No. 16.

Commonwealth of Massachusetts,
Cattle Bureau of the State Board of Agriculture,
State House, Boston, Nov. 2, 1908.

To Persons bringing Cattle into Massachusetts, and All Others whom it may concern.

Section 5 of Cattle Bureau Order No. 15 is hereby amended so as to provide as follows: —

1. Any person obtaining a permit to ship or drive neat cattle into Massachusetts from other States, upon which a tuberculin test is required, who desires to have such animals tested before shipment, will be allowed to have this done if he obtains permission from the Chief of the Cattle Bureau of the State Board of Agriculture to employ an agent of the Cattle Bureau to make such tests at the expense of the owner or shipper, such agent to be designated by the Chief of the Cattle Bureau and supplied with tuberculin by him.

2. Certificates of tuberculin test made outside the Commonwealth by said agents thus supplied with tuberculin may be accepted by the Chief of the Cattle Bureau in lieu of certificates of tuberculin test made by agents of the Cattle Bureau upon cattle after arrival in the Commonwealth, if upon examination such certificates are found to be satisfactory.

3. This order does not apply to neat cattle shipped to the Stock Yards at Brighton, Watertown or Somerville.

4. This order shall be published by sending a copy to each inspector of animals in the Commonwealth, and by furnishing a copy to each shipper of cattle into the Commonwealth upon permits issued under the provisions of section 1, Cattle Bureau Order No. 15.

This order shall take effect upon its approval.

Austin Peters,
Chief of Cattle Bureau.

Approved in Council, Nov. 11, 1908.

E. F. Hamlin,
Executive Secretary.

Miscellaneous Diseases.

In addition to rabies, glanders and bovine tuberculosis there have been a number of outbreaks of various other diseases, usually classified in these reports under the heading of "miscellaneous," such as hog cholera, blackleg or symptomatic anthrax, anthrax, actinomycosis and tuberculosis among swine.

Beside the diseases specified above, which are among the contagious diseases recognized by the statutes of the Commonwealth, as specified in section 28, chapter 90 of the Revised Laws, attention is called every year to other diseases of a communicable character that are not specified in the law as contagious, but which agents are sent to investigate and to advise owners upon, although no further action can be taken.

One of these is mange among horses. A number of cases have been reported during the year, but the law does not permit of quarantining animals affected, or compelling owners to treat cases. Occasionally an old neglected horse dies of it, but as a rule it is a disease that is amenable to treatment, and one that does not increase materially in this climate. If it should assume dimensions sufficient to make it a menace to the health and value of our equine population, no doubt horse owners would be aroused to asking for legislation, which would at once be granted if there was a popular demand for it.

Occasionally a farmer may have an outbreak of pneumonia of an infectious character in his herd, to which the attention of the Cattle Bureau is called. It is not unusual in the winter months for a farmer to buy a new cow at Brighton, or elsewhere, and after she is taken home she may develop pneumonia, or diarrhœa, and infect others in the herd, and these troubles may cause occasional fatalities. Agents of the Cattle Bureau are frequently sent to investigate cases of this kind, but as these troubles are not included in the contagious diseases specified in the law, no action is taken beyond giving the owner some good advice, and no further action is necessary or legislation needed for diseases of this kind.

There has been rather less trouble than usual from diseases classified under the generic term of "hog cholera," including hog cholera, swine plague or anything analogous to it. Outbreaks have occurred during the year in Greenfield, Colrain, Fall River, Grafton, Barnstable, Kingston and Salem, but as a rule the herds involved were not large and the losses have not been very heavy. An account of the method of im-

munizing swine from hog cholera is given in another part of this report.

Tuberculosis in swine is not at all uncommon; the cases are generally discovered at the time of slaughter, and those reported by boards of health or inspectors are enumerated on another page.

A few cattle have been quarantined with actinomycosis of the jaw, but have been released with the advice to the owner to fatten and dispose of the animals for beef before the jaw of an infected animal became so diseased as to cause it to emaciate. One case of actinomycosis of the udder was immediately condemned and killed. As the lesions were confined to the udder, the carcass was returned to the owner for beef.

Symptomatic anthrax or blackleg has been more prevalent than usual during the past season, and outbreaks have occurred in Washington, Princeton, Hubbardston, Westminster, Templeton, Royalston, Barre, Northfield, Montague, Easthampton, Southampton and Granville. Fully 30 head of young cattle have died in the infected pastures, and probably more, as some cases may not have been reported, and nearly 200 head have been given the protective inoculation with blacklegoids by agents of the Cattle Bureau.

An outbreak of true anthrax occurred in Medford in July. Five cows owned by one man and 2 owned by two other persons died. These cattle were all within a quarter of a mile of each other, and it is difficult to say which premises the infection started on, but it was very likely conveyed by flies from one man's premises to another. The man who lost 5 cows had 1 left, which was later killed. The premises were thoroughly disinfected and the place where the larger number of cattle were kept was vacated for a while. Later, 2 cows were placed upon them and they remained well until the end of November, when 1 died of anthrax; the second one has since been killed, and then the stable floor was taken up, the planks disinfected, the earth underneath covered with quicklime to a depth of two inches, the manure buried after covering it over with quicklime. The premises are now vacant, except that a horse and some hens still remain there.

It is hoped there will be no further trouble in this locality the coming spring and summer, but time alone can tell. This is the first outbreak of anthrax in Massachusetts for several years. Dr. Theobald Smith examined specimens from one of the cows that died early in August and the cow that died the latter part of November, and found the anthrax bacillus present in both cases.

Financial Statement.

At the close of the last fiscal year, Nov. 30, 1907, there was on hand, as per twelfth semiannual report: —

Balance of appropriation for salaries and expenses for 1907,	$412 92	
Balance of appropriation for general work of Bureau for 1907,	5,087 22	
Appropriated under chapter 264, Acts of 1908, for expenses in excess of appropriations in the year 1907: —		
For salaries and expenses,	367 14	
For general work of Bureau,	3,650 58	
		$9,517 86
Appropriation for salaries and expenses of 1908, chapter 46, Acts of 1908,	$7,000 00	
Appropriation for general work of Bureau for 1908, chapter 44, Acts of 1908,	70,000 00	
		77,000 00
Total to be accounted for,		$86,517 86
Expended during the year: —		
For 300 head of cattle condemned and killed during the year 1907, paid for in 1908,	$6,572 65	
For 1,351 head of cattle condemned and killed during the year,	29,116 75	
For killing and burial, quarantine claims and arbitration expenses,	60 00	
		$35,749 40
For services of agents (exclusive of glanders work),	$12,823 55	
For expenses of agents (exclusive of glanders work),	4,746 82	
Amounts carried forward,	$17,570 37	$35,749 40

Amounts brought forward, . . .	$17,570 37	$35,749 40
For expenses of quarantine stations, . .	6,298 31	
For expenses of glanders work, including services and expenses of agents, laboratory work and killing and burial, . . .	8,763 02	
For laboratory expenses (exclusive of glanders work), ...	1,978 80	
For implements, ear tags, thermometers, etc., ...	1,104 46	
For salary of Chief of Bureau, . . .	1,800 00	
For salary of clerk, ...	1,200 00	
For salaries of assistant clerks and stenographers, ...	1,780 24	
For office expenses, printing, postage, stationery, etc., ...	2,580 51	
For expenses of Chief of Bureau, . . .	260 36	
		43,336 07
Total expenditures, ...		$79,085 47
Balance from all accounts, Nov. 30, 1908, . . .		7,432 39
Total, as above, ...		$86,517 86

This balance is made up from the following items: —

Balance of appropriation on account salary and expenses, 1907, ...	$239 20	
Balance of appropriation for excess expenses, 1907, ...	398 20	
Balance of appropriation for salary and expenses, 1908 account, ...	94 55	
Balance of appropriation for general work of Bureau available for unsettled accounts of 1908, ...	6,700 44	
		$7,432 39

Claims for 580 head of cattle condemned and killed as tuberculous during the year remain unsettled, to be paid for on proof of claims, the appraised value of which amounts to $11,935.66.

There has been received during the year, from the sale of hides and carcasses of condemned animals, sale of ear tags, testing cattle for non-resident owners, etc., $4,854.81.

The average price paid for condemned cattle for the year was $21.55 each.

Under the requirements of chapter 220, Acts of 1903, 32 branding stamps, for use in the inspection of meat, have been furnished to 27 cities and towns by the Bureau during the year.

It will be seen by the foregoing statement that a balance of $7,432.39 from all accounts was left on hand Nov. 30, 1908. When all the claims against the Cattle Bureau come in for the fiscal year just ended, this sum will not be sufficient to settle them, and there will be a deficit in the appropriation.

The Legislature of 1908 passed a deficiency appropriation bill on account of the Cattle Bureau amounting to $3,917.72, and it is feared that the deficit for the year ending Nov. 30, 1908, will be double this amount, and possibly a little more.

Estimates made to the Auditor under the requirements of chapter 211, Acts of 1905, for the fiscal year ending Nov. 30, 1909, are for $92,500, divided into $7,500 for the salaries of the Chief of the Cattle Bureau and his clerk, extra clerical assistance, printing, postage and general office and incidental expenses, and $85,000 for the general outside work in exterminating contagious diseases among horses and other animals.

This estimate is somewhat larger than the amount of the regular appropriations made by the Legislature for the Cattle Bureau during the past few years, but a larger amount seems necessary. The work of the office has to be figured very closely to keep its expenses inside the $7,000 usually allowed, and in the general field work there has been a deficiency of from $3,600 to $11,500 every year since the Cattle Bureau was established, hence it would seem as well to make a larger appropriation at the beginning of the year as to make a deficiency appropriation at the next legislative session.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

EIGHTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1909.

Dairy Bureau—1908.

CARLTON D. RICHARDSON, West Brookfield, *Chairman.*
HENRY E. PAIGE, Amherst.
WARREN C. JEWETT, Worcester.

Secretary.
J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.
P. M. HARWOOD.
Address, Room 136, State House, Boston.

REPORT.

The year 1908 has not been unusual in point of violations of dairy laws; in fact, the number of such violations has been rather less than in some previous years; 104 prosecutions for violations of oleomargarine laws, 51 for violations of the renovated butter law and 14 for violation of the milk laws is the record. The amount of oleomargarine handled in the State is about the same as formerly; it is, however, handled in more legitimate ways. Renovated butter seems to be falling off in total sales. The greatest popular interest has been in the cases for violation of the milk laws.

During the early part of the year there was much agitation in relation to the milk standard. Numerous bills were presented to the Legislature, with the result that a new standard was adopted. The standard now calls for 12.15 per cent total milk solids and 3.35 per cent milk fats throughout the entire year.

There is a strong and growing feeling in the State — a feeling that is shared by nearly all classes — that the milk standard law, unwisely enforced, incurs unwarranted hardship upon the producer. In the opinion of this Bureau such a law is mainly for the purpose of holding the milk product at a given point, in the interests of the public at large. Our policy and practice is, wherever we find milk which contains added water, to put the person nearest responsible for the condition of such milk into court under the milk adulteration act (R. L., c. 56, § 55). Whenever we find milk below the standard and still apparently unadulterated, we first notify the producer, and frequently offer him suggestions as to how to improve its quality. We find pro-

ducers as a rule desirous of obeying the laws of our Commonwealth, and have thus far found no difficulty in procuring the desired result without resorting to the extreme of prosecution.

Some persons think that a small amount of water can be added to milk without detection. This we believe to be a mistake. The moment a man begins to add even a small amount of water to milk, be becomes an object of suspicion to the chemist who makes the analysis. It is an unwise and dangerous thing to do, and the quicker such notion is driven out of the heads of those who produce and handle milk, the better. A man can hardly make a greater mistake than to add water to the milk with any assurance of not being detected sooner or later. This is a fact well recognized by those who enforce the laws. The man who starts on a down grade goes lower and lower with each advancing step. If it is a matter of adding water to milk, some day he will get caught.

In looking over the lists of defendants as prosecuted by the Dairy Bureau for various offences during the last six years, it is gratifying to note that out of the 570 different defendants only 17 have repeated, or had to be brought into court a second time.

In the educational work 22 meetings have been addressed by the members of the Bureau and its general agent. Investigations have been made concerning milk as produced on Massachusetts farms. Farmers have been urged to co-operate; to raise more grain; to use more reasonable care in the production and handling of milk, etc. Consumers have been urged to their part in properly caring for milk after it has been delivered; to use more milk; and not to object to a reasonable price for the good, clean article, recognizing that such milk cannot be produced at a low price.

A new "Manual of Dairy Laws of Massachusetts," with annotations and a digest of Supreme Court decisions, has been prepared by the general agent.

Two years ago we suggested the desirability of a Massachusetts Dairymen's Association, combining all the dairy

interests of the State, for the purposes of co-operation, holding of dairy exhibits, etc., uplifting by competition and friendly rivalry to see who can produce the best goods, whether it be milk, cream, butter or other milk product. Such an association properly organized and officered should offset the pessimistic and depressing views too often taken of the milk situation. Upbuilding forces from within and of the producers themselves are now most needed. We therefore again urge the dairy-producing industry of this State to thus organize.

The personnel of the Bureau and its staff has changed only in one respect, W. C. Jewett having been appointed by Governor Guild in place of John M. Danforth, whose term had expired. C. D. Richardson has continued as chairman, H. E. Paige as a member, J. Lewis Ellsworth secretary, P. M. Harwood general agent, A. W. Lombard agent, B. F. Davenport and H. C. Emerson chemists, and four persons have been temporarily employed as agents during some part of the year.

The summary of the year's work is as follows: —

Total number of inspections,	[1] 7,091
Number of inspections where no sample was taken,	5,516
Number of samples of butter and oleomargarine, all purchased,	1,497
Number of samples of milk and cream, many of which were purchased,	321
Cases entered in court,	[2] 171
Cases tried in court,	169
Meetings addressed by chairman of the Bureau,	10
Meetings addressed by Mr. Jewett,	2
Meetings addressed by the general agent,	10

Cases prosecuted during the twelve months ending Nov. 30, 1908, by months and courts, with law violated, and results, are as follows: —

[1] There were 243 extra samples taken during the inspections, therefore this number is 243 less than the sum of the next three items.

[2] Defendant in two cases ran away after having been summoned.

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Malden, .	December,	2	1 oleomargarine, 1 renovated butter.	2	–
Woburn, .	January, .	1	Milk, . . .	1	–
Worcester, .	January, .	1	Milk, . . .	1	–
Ware, . .	January, .	3	Milk, . . .	3	–
North Adams,	February, .	22	18 oleomargarine, 4 renovated butter.	22	–
Greenfield, .	February, .	1	Milk, . . .	1	–
Woburn, .	February, .	2	Renovated butter, .	–	2
Lawrence, .	February, .	12	4 renovated butter, 8 oleomargarine.	12	–
Peabody, .	February, .	2	Renovated butter, .	2	–
Salem, . .	March, .	19	16 oleomargarine, 3 renovated butter.	19	–
Brockton, .	March, .	7	2 oleomargarine, 4 renovated butter, 1 milk.	7	–
Dedham, .	March, .	5	Renovated butter, .	5	–
Lynn, . .	March, .	8	Oleomargarine, .	8	–
Lynn, . .	April, .	8	4 oleomargarine, 4 renovated butter.	8	–
Holyoke, .	April, .	8	2 oleomargarine, 6 renovated butter.	8	–
Ipswich, .	April, .	12	Oleomargarine, .	12	–
Greenfield, .	April, .	1	Milk, . . .	1	–
Worcester, .	April, .	12	Oleomargarine, .	12	–
Taunton, .	April, .	8	6 oleomargarine, 2 renovated butter.	8	–
Lowell, . .	May, .	4	Oleomargarine, .	4	–
Newburyport,	May, .	3	Renovated butter, .	2	1
Spencer, .	May, .	2	Oleomargarine, .	2	–
Woburn, .	June, .	2	Milk, . . .	2	–
Cambridge, .	June, .	4	Renovated butter, .	4	–
Cambridge, .	July, . .	8	4 renovated butter, 4 oleomargarine.	8	–

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Worcester,	July,	3	2 renovated butter, 1 oleomargarine.	3	–
Cambridge,	August,	2	Oleomargarine,	2	–
Orange,	September,	1	Milk,	1	–
Ayer,	October,	1	Milk,	–	1
Greenfield,	October,	1	Milk,	1	–
Medford,	November,	1	Renovated butter,	1	–
Springfield,	November,	1	Milk,	1	–
Spencer,	November,	2	Oleomargarine,	2	–
Totals,		169		165	4

Note. — The Bureau is especially indebted to the milk inspectors of Greenfield, Northampton, Springfield, Taunton, Winchester and Worcester, whose work with us has resulted in cases in court during the year. We also record our indebtedness to all others who have aided us in any way.

The charges in the several cases entered in court for the year ending Nov. 30, 1908, have been as follows: —

Selling renovated butter in unmarked packages,	51
Selling oleomargarine without sign on exposed contents,	1
Selling oleomargarine when butter was asked for,	18
Selling oleomargarine without being registered,	11
Selling oleomargarine without sign in store,	10
Selling oleomargarine in unmarked packages,	6
Selling oleomargarine from restaurants without notice to guests,	[1] 60
Selling milk containing added water,	12
Selling skimmed milk from unmarked cans,	1
Selling cream below standard,	1
	171

[1] Two cases were entered but not tried, as defendant ran away after being summoned.

The following is a list of inspections without samples and the number of samples taken in the years 1903–08, inclusive: —

YEAR.	Inspections without Samples.	Samples taken.
1903,	4,135	1,395
1904,	4,456	1,157
1905,	4,887	971
1906,	4,985	576
1907,	4,538	1,374
1908,	5,516	1,575
Totals,	28,517	7,048
Averages,	4,752	1,174

Oleomargarine.

For the second time we are able to announce that no licenses for the sale of colored oleomargarine have been issued in this State, and no sale of such goods has been reported to the Bureau during the year.

The following figures show the oleomargarine output for the United States since 1900: —

	Pounds.
Under Old Law.	
1900,	107,045,028
1901,	104,943,856
1902,	126,316,472
Under New Law.	
1903,	71,804,102
1904,	48,071,480
1905,	49,880,982
1906,	53,146,657
1907,	68,988,850
1908,	79,107,273

It will be noticed that the increase of the 1908 output over that of 1907 was 14 per cent, or only about one-half the increase of 1907 over 1906.

The oleomargarine licenses issued in this State have slightly increased over last year, now being as follows: —

Retail, uncolored,	256
Wholesale, uncolored,	21
Total,	277

Renovated Butter.

The use of renovated butter in this State is apparently on the decline, according to our inspectors' reports. Most of the goods now sold are in the print form. The cases in court during the year for violation of the renovated butter law, 51, was the smallest number since 1902. There is now but one licensed concern in this State manufacturing renovated butter.

Butter.

The consumption of butter is on the increase year by year, keeping reasonable pace with the increase in population, as shown by the Chamber of Commerce figures for the years from 1900 to 1908: —

	Pounds.
1900,	49,288,306
1901,	50,565,193
1902,	51,897,478
1903,	52,185,924
1904,	56,016,157
1905,	59,596,542
1906,	63,343,776
1907,	63,568,240
1908,	66,772,183
Average annual increase for nine years,	1,942,653

These figures are encouraging, and show that imitations have not as yet made serious inroads into the butter business.

The creameries at Montague and North Orange have been sold and have gone out of business.

The average price paid the local creamery patrons has not varied materially from last year. The average wholesale price of butter in Boston, however, has been about 1 cent per pound lower than in 1907.

The following table shows the average quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last nine years: —

	1908. Cents.	1907. Cents.	1906. Cents.	1905. Cents.	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.
January,	29.7	30.4	25.2	28.0	22.7	28.0	25.0	25.0	29.5
February,	32.1	31.7	25.2	31.6	24.6	27.0	28.5	25.0	26.0
March,	30.2	30.2	25.5	28.0	24.1	27.0	29.0	23.0	27.0
April,	28.4	32.2	22.2	29.1	21.6	27.5	32.0	22.0	21.0
May,	24.1	31.4	19.9	23.9	19.9	22.5	25.0	19.5	20.5
June,	24.5	24.3	20.2	20.7	18.4	22.75	23.5	20.0	20.5
July,	23.6	25.9	21.0	20.6	18.3	20.5	22.5	20.0	20.5
August,	24.5	26.0	23.8	21.6	19.1	20.0	21.5	21.0	22.0
September,	25.3	29.2	25.6	21.2	20.8	22.0	23.5	22.0	22.5
October,	27.5	29.9	26.9	22.1	21.5	22.5	24.5	21.5	22.0
November,	29.5	27.1	27.6	23.0	24.1	23.5	27.0	24.0	25.0
December,	31.0	27.5	30.7	23.9	25.7	24.5	28.5	24.5	25.5
Averages,	27.5	28.48	24.48	24.47	21.73	26.23	25.0	22.3	23.5

The Chamber of Commerce figures regarding the butter business in Boston for 1907 and 1908 are as follows: —

	1908. Pounds.	1907. Pounds.
Carried over,	6,854,760	6,851,825
Receipts for January,	2,875,253	2,652,155
Receipts for February,	2,529,472	2,669,598
Receipts for March,	3,182,045	2,731,791
Receipts for April,	3,570,013	3,504,867
Receipts for May,	6,123,261	5,339,155
Receipts for June,	11,675,687	8,559,668
Receipts for July,	11,534,423	10,711,647
Receipts for August,	8,800,812	8,703,341
Receipts for September,	8,990,275	6,778,041

	1908. Pounds.	1907. Pounds.
Receipts for October,	4,707,422	5,982,162
Receipts for November,	2,268,606	3,302,617
Receipts for December,	3,585,918	2,654,185
Total supply,	76,688,947	70,441,052
Exports for twelve months, deduct,	868,164	18,052
Net supply,	75,820,783	70,423,000
Storage stock December 26, deduct,	9,048,600	6,854,760
Consumption for twelve months,	66,772,183	63,568,240
Increase in consumption for 1908,	3,203,943	

Cream.

There has been a very great increase in the amount of cream shipped into and consumed in this State during the last ten years. It is estimated that a total of at least 2,000,000 gallons of cream is now handled in Boston alone. This of course is not all consumed in Boston. Another interesting fact is that there is now a much larger proportionate quantity of heavy cream used than was formerly the case. According to the last report of the Boston milk inspector, there are 84 creameries shipping cream to Boston dealers, as follows: —

Vermont,	36
Maine,	23
New Hampshire,	12
New York,	9
Massachusetts,	4
Total,	84

This cream is mostly "pasteurized." What is known as light cream runs from 15 to 20 per cent, and heavy cream from 35 to 45 per cent milk fat. A standard for cream, calling for at least 15 per cent milk fat, was established by the Legislature of 1907.

Milk.

There are two facts in connection with the dairy business in Massachusetts worthy of note, the first being that the assessors' returns for the last three years show a decline in the number of milch cows, May 1, 1908, showing 7,617 less than were assessed May 1, 1907. Among the reasons apparently responsible for this may be mentioned competition from other States, decreased consumption of raw whole milk, increased requirements by health authorities and the demands of the times, high cost of grain and scarcity of competent farm help. The second fact is disclosed by the report of the milk shipped into Boston by rail, as per returns to the Railroad Commissioners, which for the twelve months covered in this report was 103,831,278½ quarts, as against 109,882,190½ quarts in 1907 and 114,233,976 quarts in 1906, — a reduction of 6,050,912 quarts from last year, when there was a reduction of 4,351,785½ quarts from the year before, making a total drop in two years of nearly ten and a half million quarts, and this in the face of a constantly increasing population. This reduction was constant, month by month, with two exceptions, from December, 1906, to September, 1908, when a gain commenced to show itself. Of course this is not an exact measure of the decline in the use of raw whole milk in greater Boston, but it is a strong indication that there has been a serious decline in that respect. Some of the causes which have conspired to bring about this condition appear to be: first, that there has been too much "scare" about the use of raw milk; second, there has been too much prejudice raised against paying the price necessary to procure the good, clean article of milk now upon the market; third, the increased use of powdered, concentrated and condensed milks; fourth, the increased use of cream; and fifth, the working people have been more or less unemployed during portions of this period. Perhaps this was all necessary under the circumstances, but is it not a condition to be regretted? Science supports and theory and practice endorse the fact that there is no milk so easily

digested and nutritious as good, clean, whole milk, just as the cow gives it.

Let us hope, then, that the time is at hand when confidence will be restored and the public once more brought to consume its normal amount of raw whole milk.

The price of carred milk has remained the same as one year ago, that paid to the producer at the car for the entire territory supplying it averaging 3.33 cents per quart in summer and 4.17 cents per quart in winter, wherever cans are washed by the contractors, — a price still too low, considering the demands of present-day conditions.

The question of the constitutionality of the milk standard law has been again raised, and is now pending in the Supreme Court.

Appended Tables.

Table I. shows analysis of milk just as it was delivered at the railroad stations by 44 farmers, in June, 1908, and gives a fair idea of the condition of early summer milk as regards solid content in the milk-producing districts at that time of the year.

Tables II. and III. show a method of dealing with those producers who are complained of for selling milk which, while it is unadulterated, is below the legal standard.

Table IV. shows analyses where two out of eleven cans of milk contained added water. This case was appealed from district to Superior Court, fought out before a jury, and the sentence of lower court confirmed.

Table V. shows a case where all the cans of milk contained added water, also analyses of samples of milk of known purity from individual animals in the herd producing the milk.

Table VI. shows analyses of milk and cream where prosecutions followed.

Table VII. shows number of cows assessed in Massachusetts at different periods.

Table VIII. shows amount of milk brought into Boston by different railroads for the twelve months covered by this report, and totals for the two preceding years.

TABLE I. — *Samples of Milk for Boston Market, as delivered at Car by Farmers, taken from C. Brigham Company, at Barre Plains, Mass.*

SAMPLE NO.	Number Cans.	Number Cows.	Solids not Fat.	Fat.	Total Solids.	Ash.	Refraction.
1,[1]	7	8	8.92	2.80	11.72	.66	43.3
2, ...	12	12	8.80	3.20	12.00	.62	43.8
3, ...	33	30	8.56	3.00	11.56	.68	42.5
4, ...	21	15	8.78	3.30	12.08	.66	43.5
5, ...	16	–	8.38	3.10	11.48	.58	42.1
6, ...	29	20	8.70	3.30	12.00	.54	42.9
7, ...	13	14	8.48	3.70	12.18	.54	42.8
8, ...	14	11	8.70	3.10	11.80	.56	42.0
9, ...	19	19	8.66	3.80	12.46	.56	43.2
10, ...	11	10	8.10	3.20	11.30	.56	43.3
11, ...	7	5	9.14	3.40	12.54	.54	44.2
12, ...	17	16	8.56	3.30	11.86	.60	42.3
13, ...	6¼	10	9.42	3.90	13.32	.66	44.9
14, ...	10	–	8.78	4.30	13.08	.70	43.0
15, ...	12	10	8.94	4.00	12.94	.62	43.6
16, ...	16	–	8.56	3.30	11.86	.70	42.3
17, ...	6	–	8.76	3.40	12.16	.56	43.2
18, ...	24	20	8.76	4.00	12.76	.60	43.7
19,[1]	16	11	9.28	2.80	12.08	.60	44.0
20, ...	18	16	8.48	3.40	11.88	.62	42.2
21, ...	18	14	8.66	3.50	12.16	.60	43.2
22, ...	14	14	8.76	3.30	12.06	.56	43.9
23, ...	6	–	8.60	4.00	12.60	.60	43.2
24, ...	21	–	8.90	3.40	12.30	.56	43.4
25, ...	4	–	8.26	3.90	12.16	.50	42.1
26, ...	4	4	8.90	3.00	11.90	.64	42.4
27, ...	5	–	8.80	4.20	13.00	.60	43.5
28, ...	6	–	8.74	3.90	12.64	.64	43.3
29, ...	7	–	9.00	3.90	12.90	.56	42.7
30, ...	9	–	8.80	4.00	12.80	.70	43.8
31, ...	8	9	9.16	3.70	12.86	.62	43.6
32, ...	7	4	8.10	4.30	12.40	.58	42.2
33, ...	9	13	8.44	3.60	12.04	.58	42.2
34, ...	20	20	8.88	3.40	12.28	.56	43.2
35, ...	18	16	8.00	3.90	11.90	.56	43.0
36, ...	10	8	8.40	3.10	11.50	.54	42.2
37,[2]	15	15	–	–	–	–	–
38, ...	11	10	9.54	3.70	13.24	.62	44.9
39, ...	9	8	9.18	3.20	12.38	.62	43.7
40, ...	7	–	8.98	3.70	12.68	.54	43.4
41, ...	7	–	8.86	4.10	12.96	.64	43.2
42, ...	11	10	8.84	4.10	12.94	.68	43.6
43, ...	10	–	9.00	3.80	12.80	.60	42.5
44, ...	14	15	8.50	3.70	12.20	.58	43.2
Average analysis of 41 samples,			8.73	3.61	12.34	.60	43.1

[1] Manifestly not normal milk, therefore not figured in the averages. [2] Sample lost.

NOTE. — This milk was afterward mixed and recanned before shipping to Boston, making a milk of good standard quality. It will be observed, however, that in point of solids not fat the normal milk varied from 8 to 9.54 per cent; in fat the variation was from 3 to 4.3 per cent; and in total solids from 11.48 to 13.32 per cent. It will be noticed also that 13 of the 41 samples of normal milk were below the legal standard in fat, and 15 were below the legal standard in total solids.

TABLE II. — *Analysis of Samples of Milk taken from Cans of a Farmer, as delivered to the Springfield Co-operative Milk Association.*

SAMPLE NO.	Solids not Fat.	Fat.	Total Solids.	Refraction.
4, ...	8.97	4.8	13.77	–
5, ...	9.19	4.0	13.19	–
6, ...	8.82	3.4	12.22	–
7, ...	9.12	4.5	13.62	–
8, ...	8.68	3.8	12.48	–
9, ...	8.45	3.6	12.05	–
10, ...	8.51	3.2	11.71	42.5
11, ...	8.40	3.4	11.80	41.7
12, ...	8.21	3.4	11.61	41.4
13, ...	8.86	3.8	12.66	–
14, ...	8.42	3.2	11.62	42.0
15, ...	8.59	3.9	12.49	–
16, ...	8.29	3.2	11.49	41.4
17, ...	8.06	3.5	11.56	41.0

NOTE. — There being nothing about the chemical analysis of this milk or the refraction of light in the milk serum to indicate added water, further investigation was made and samples of known purity were taken, as shown in Table III.

TABLE III. — *Analysis of Milk of Known Purity taken from Individual Animals, and the Mixed Milk of the Herd producing the Milk referred to in Table II.*

Cow No.	Breed and Amount.	Solids not Fat.	Fat.	Total Solids.	Ash.	Refraction.
1	——, 4 quarts, . . .	8.47	3.3	11.77	.71	41.9
2	Registered Holstein, 4½ quarts,	8.33	3.6	11.93	.68	41.2
3	High-grade Holstein, 8 quarts,	8.16	3.6	11.76	.65	42.6
4	High-grade Holstein, 7 quarts,	8.22	3.1	11.32	.64	42.2
5	Ayreshire, 6 quarts, . .	8.78	3.4	12.18	.71	42.5
6	Shorthorn, 5 quarts, . .	8.72	3.7	12.42	.68	42.5
7	Ayreshire and Holstein, 4 quarts.	8.38	3.8	12.18	.65	42.5
8	High-grade Holstein, 4 quarts,	8.61	3.2	11.81	.67	42.0
9	Holstein and Hereford, 4 quarts.	8.45	3.6	12.05	.66	42.3
10	——, 4 quarts, . . .	9.29	4.2	13.49	.71	43.7
11	Pure-bred Holstein, 1 pint, .	11.74	6.6	18.34	1.02	49.9
12	——, 3 quarts, . . .	9.22	4.1	13.32	.69	43.5
13	Sample lost, ...	–	–	–	–	–
	Mixed milk of thirteen cows,	8.57	3.5	12.07	.69	42.6

NOTE. — The owner of this herd was advised to buy a mixing can (which he did), and then, if the milk did not come up to standard, to either dispose of one or more cows giving milk of low quality and replace with cows giving milk richer in solids, or to use the fore milk of the poorer cows for some other purpose. The milk from this herd has since been satisfactory.

TABLE IV. — *Analysis of Milk taken from a Massachusetts Producer, September, 1908.*

Agent's No.	Producer's Mark.	Chemist's No.	Solids not Fat.	Fat.	Total Solids.	Refraction.	Condition.
34, ...	9	9,938	8.74	4.0	12.74	41.8	O.K.
35, ...	9	9,939	8.71	4.0	12.71	41.8	O.K.
36, ...	9	9,940	8.79	4.0	12.79	41.8	O.K.
37, ...	9	9,941	8.76	4.0	12.76	42.3	O.K.
38, ...	9	9,942	8.76	4.0	12.76	42.1	O.K.
39, ...	9+	9,943	6.16	3.0	9.16	33.7	Watered.
45, ...	9+	9,944	8.65	5.2	13.85	43.1	O.K.
46, ...	9+	9,945	8.96	5.1	14.06	43.2	O.K.
47, ...	9+	9,946	5.48	3.4	8.88	31.7	Watered.
48, ...	9+	9,947	8.78	5.5	14.28	43.1	O.K.
49, ...	9+	9,948	8.83	5.0	13.83	43.2	O.K.

NOTE. — The samples were taken in the evening, those marked 9 being the freshly drawn and mixed night's milk. The fat in these samples showed absolutely no variation and .08 of 1 per cent was the widest variation shown in solids not fat, and ½ of 1 degree was the widest variation in the refraction of light, all of which shows how carefully the samples were taken and analyzed. The cans marked 9+ were said by the defendant to contain mixed morning's milk which had stood all day, and of course it was more difficult to so thoroughly mix in taking samples; nevertheless, the widest variation in total solids was .45 of 1 per cent. The refraction of light in the milk serum rarely if ever goes below 40 in samples of mixed milk. The analysis of the two samples of watered milk indicates, notwithstanding the mark of 9+ on the stopper, that milk sample 39 was, in a large measure at least, night's milk. The story told by this table is that cans 39 and 47 originally contained only about five quarts of milk each and subsequently had been filled with water.

TABLE V. — *Analysis of Samples of Milk taken from Cans as delivered by a Farmer to a Milk Peddler, in a Western Massachusetts City.*

Sample No.	Mark on Can.	Solids not Fat.	Fat.	Total Solids.	Refraction.
1, ...	X	8.11	3.6	11.71	38.65
2, ...	X	8.13	3.6	11.73	38.60
3, ...	X	8.09	3.6	11.69	38.30
4, ...	I	8.06	3.8	11.86	38.50
5, ...	I	7.88	3.8	11.68	38.05
6, ...	I	8.26	3.9	12.16	39.05

Analysis of Samples of Known Purity from the Above Owner's Herd.

Sample No.	Cows.	Amount (Quarts).	Solids not Fat.	Fat.	Total Solids.	Refraction.
1, . .	4 and 5	5	8.58	3.8	12.38	42.0
2, . .	8	4	8.72	4.7	13.42	41.3
3, . .	3	6	9.10	4.0	13.10	41.9
4, . .	9	4	9.04	4.1	13.14	42.3
5, . .	6 and 7	7	8.89	6.7	15.59	42.5
6, . .	2	4	8.68	5.2	13.88	41.8

NOTE. — The above-mentioned farmer was summoned into court and pleaded guilty to having in his possession, with intent to sell, milk to which water had been added, and was fined $50, which he paid.

TABLE VI. — *Milk Analyses upon which were based the Prosecutions of 1908.*

Case No.	Solids not Fat.	Fat.	Total Solids.	Refraction.	Remarks.
1,	8.24	3.2	11.44	39.0	Showed added water.
2,	7.36	3.6	10.96	37.2	Showed added water.
3,	7.41	3.6	11.01	37.9	Showed added water.
4,	8.64	2.8	11.44	42.4	Showed skimming.
5,	6.99	3.6	10.59	37.4	Showed added water.
6,	9.64	.03	9.67	–	Skimmed milk sold from unmarked can.
7,	5.79	2.5	8.29	33.2	Showed added water.
8,	–	7.2	–	–	Showed cream below standard.
9,	6.66	3.8	10.46	34.0	Showed added water.
10,	7.60	3.10	10.70	33.0	Showed added water.
11,	6.92	3.8	10.72	35.6	Showed added water.
12,	6.56	3.1	9.66	35.8	Showed added water.
13,	5.48	3.4	8.88	31.7	Showed added water.
14,	7.88	3.8	11.68	38.05	Showed added water.

[1] Cream.

TABLE VII. — *Number of Cows assessed in Massachusetts, by Five-year Periods, 1865–1905; — Annually, 1905–08.*

May 1, 1865,	145,801
May 1, 1870,	161,185
May 1, 1875,	149,765
May 1, 1880,	174,859
May 1, 1885,	167,817
May 1, 1890,	200,658
May 1, 1895,	175,016
May 1, 1900,	180,245
May 1, 1905,	181,920
May 1, 1906,	181,816
May 1, 1907,	179,075
May 1, 1908,	171,458

TABLE VIII. — *Milk brought into Boston by Different Railroads, December, 1907, to December, 1908, as reported by the Railroad Commissioners.*

DATE.	Boston & Albany (Quarts).	Boston & Maine (Quarts).	New York, New Haven & Hartford (Quarts).	Total (Quarts).
1907.				
December,	1,174,929	5,171,399	1,817,197	8,163,525
1908.				
January,	1,241,221	5,293,584	1,934,791	8,469,596
February,	1,178,499	4,925,676	1,822,678	7,926,853
March,	1,147,551	5,695,014	2,013,002	8,855,567
April,	1,328,558	5,254,103	1,987,127	8,569,788
May,	1,524,713	5,536,851½	2,029,476	9,091,040½
June,	1,541,900	5,857,026	1,985,393	9,384,319
July,	1,349,026	5,964,741	1,858,796	9,172,563
August,	1,299,259	5,785,903	1,817,954	8,903,116
September,	1,317,270	5,493,163	1,806,924	8,617,357
October,	1,318,707	5,347,172	1,984,437	8,650,316
November,	1,169,345	5,017,521	1,840,372	8,027,238
Total,	15,590,978	65,342,153½	22,898,147	103,831,278½

Total for corresponding twelve months, 1905–06, 114,233,976 quarts.
Total for corresponding twelve months, 1906–07, 109,882,190½ quarts.

CREAMERIES, MILK DEPOTS, ETC.

Appended we give a revised list of the principal creameries, milk depots, etc., owned and operated by Massachusetts individuals and corporations. There are in this State, in addition to these, a number of distributing plants for creameries owned and operated in other States. For instance, the Maine Creamery Company of Bangor, Me., has offices at 12 Foster Wharf, Boston. The Turner Centre Creamery of Auburn, Me., has distributing houses in Boston, Worcester, Taunton and Lowell, and ships to these points butter, cream, and to one at least skimmed milk.[1] The New England Creamery of Livermore Falls, Me., distributes through a Massachusetts company of the same name

[1] Pasteurized skimmed milk and cream are put together in the proper proportions required for standard milk, in the Boston plant, and the milk thus made is placed upon the market.

in Everett, which also distributes the "Hampden Creamery" goods. The Lyndonville Creamery of Lyndonville, Vt., has a plant at Watertown, from which it distributes milk, cream and butter. J. L. Humphrey, Jr., has four plants, one each in New Bedford, Fall River, Taunton and Brockton, for the distribution of butter and renovated butter from his Iowa creameries. The Armours, Swifts, Hammonds, Morrises and other large packing houses, all representing western-made goods, distribute quantities of butter and renovated butter from their numerous establishments scattered over the State. Some of these also put out oleomargarine. Besides these, there is a considerable number of creamery companies and so-called creameries which buy their stock of producers in this and other States. These in the aggregate do a large business. Other private dairies or creameries also have town offices, restaurants, etc. The above is difficult of strict classification.

A number of dairies are producing milk and cream under conditions and of a quality which command a price higher than that ruling the general market, and several, including that of the Massachusetts Agricultural College, are making certified milk.

Co-operative Creameries.

Location.	Name.	Superintendent or Manager.
1. Ashfield, . . .	Ashfield Creamery, . .	William Hunter, manager.
2. Belchertown, . .	Belchertown Creamery, .	M. G. Ward, president.
3. Cheshire (P. O. Adams).	Greylock Creamery, . .	C. J. Fales, president.
4. Cummington, . .	Cummington Creamery, .	M. S. Howes, president.
5 Easthampton, . .	Hampton Creamery, . .	W. H. Wright, treasurer.
6. Egremont (P. O. Great Barrington).	Egremont Creamery, .	C. A. Tyrrell, manager.
7. Lee, . . .	Lenox Creamery, . .	P. A. Agnew, manager.
8. Monterey, . .	Berkshire Hills Creamery, .	Henry Clapp, treasurer.
9. New Boston, . .	Berkshire Creamery, . .	F. M. Rugg, president.
10. New Salem (P. O. Millington).	New Salem Creamery, .	W. A. Moore, president.
11. Northfield, . .	Northfield Creamery, .	L. R. Smith, superintendent
12. Shelburne, . .	Shelburne Creamery, . .	Ira Barnard, manager.
13. Westfield (P. O. Wyben).	Wyben Springs Creamery,	C. H. Wolcott, manager.
14. West Newbury, .	West Newbury Creamery, .	R. S. Brown, treasurer.
15. Williamsburg, . .	Williamsburg Creamery, .	E. T. Barrus, president.
16. Worthington (P. O. Ringville).	Worthington Creamery, .	M. R. Bates, superintendent.

Proprietary Creameries.

Location.	Name.	Owner or Manager.
1. Amherst,	Amherst Creamery,	F. J. Humphrey, agent.
2. Amherst,	Fort River Creamery,	E. A. King.
3. Boylston,	Adelpha Creamery,	E. M. Laws.
4. Bridgewater,	Plymouth County Creamery.[1]	S. Neilson Houlburg.
5. Brimfield,	Crystal Brook Creamery,	F. N. Lawrence.
6. Everett,	Hampden Creamery Company.	Hampden Creamery Company.
7. Framingham (P. O. South Framingham).	Echo Farm Company,[1]	J. A. Turner.
8. Fitchburg, 26 Cushing Street.	Fitchburg Creamery,	G. S. Learned.
9. Gardner,	Boston Dairy Company,	Boston Dairy Company.
10. Groton,	Lawrence Creamery,	Myron P. Swallow.
11. Heath,	Cold Spring Creamery,	I. W. Stetson & Son.
12. Hinsdale,	Hinsdale Creamery,	Ashley B. Clark, treasurer.
13. Marlborough,	Este's Creamery,	F. F. Este.
14. North Brookfield,	North Brookfield Creamery,	H. A. Richardson.
15. Shelburne Falls,	Shelburne Falls Creamery,	T. M. Totman.
16. Uxbridge,	Farnum Creamery,	Geo. A. Farnum.

[1] Cream only.

Educational.

Amherst,	Dairy Industry Course, Massachusetts Agricultural College.	W. P. B. Lockwood, professor in charge.

Milk-distributing Depots.

Name.	Location.	Manager.
Alden Bros.,	Boston, office 1171 Tremont Street, depot 28 Duncan Street.	Charles L. Alden.
Boston Dairy Company,	Boston, 484 Rutherford Avenue,	W. A. Grostein.
Elm Farm Milk Company,	Boston, Wales Place,	James H. Knapp.
H. P. Hood & Sons,	Boston, 494 Rutherford Avenue, 24 Anson Street, Forest Hills.	Charles H. Hood.
	Lynn, 193 Alley Street.	
	Malden, 425 Main Street.	
	Salem, 252 Bridge Street.	
	Watertown, 289 Pleasant Street.	
D. Whiting & Sons,	Boston, 570 Rutherford Avenue,	George Whiting.

Milk-distributing Depots — Concluded.

Name.	Location.	Manager.
C. Brigham Company,	Cambridge, 158 Massachusetts Avenue.	John K. Whiting.
Deerfoot Farm,	Southborough,	S. H. Howes.
Springfield Co-Operative Milk Association.	Springfield,	F. B. Allen.
Tait Bros.,	Springfield,	Tait Bros.
Wachusett Creamery,	Worcester,	E. H. Thayer & Co.

Milk Laboratories.

Walker-Gordon Laboratory.	Boston, 1111 Boylston Street,	George Franklin.
H. P. Hood & Sons, Dairy Laboratory.	Boston, 70 Huntington Avenue,	W. M. Brown.

Receiving Depots for Milk for New York City.

F. D. Shove Milk Factory,	West Stockbridge,	C. E. Hardy.
Willow Brook Dairy Company.	Sheffield,	George Patterson.

Expenses.

The following is a classified statement of the expenses for the year ending Nov. 30, 1908: —

Bureau: compensation and travelling expenses,	$377 63
Agents: compensation,	2,192 50
Agents: travelling expenses and samples purchased,	2,625 94
General agent: travelling and necessary expenses,	523 35
Chemists: analyses, tests, court attendance,	1,796 20
Printing and supplies,	248 38
Educational,	236 00
Total,	$8,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

CARLTON D. RICHARDSON.
HENRY E. PAIGE.
W. C. JEWETT.

FIFTH ANNUAL REPORT

OF THE

STATE FORESTER.

REPORT OF THE STATE FORESTER.[1]

To the General Court.

It is with continued pleasure that I submit this, the fifth annual report of the State Forester of this Commonwealth.

The office has increased in usefulness, and the work along all lines has been greatly enlarged. With forest products in constantly increasing demand, and thus all kinds of woods quickly finding a ready market, our people realize that right here in Massachusetts much of our cheap lands can be made more productive, and hence valuable in proportion to how well we care for them.

The forest warden act first went into effect last spring, and, although we have had but one season to test its efficiency, there can be no doubt but that this one natural channel of definite authority and usefulness will work wonders in establishing a successful State forest policy. These 343 forest wardens, one in each town and city with forested area, have already done valiant service, and when they are more experienced and are given public-spirited encouragement by our people throughout the State, they are bound to become great factors for good everywhere. With such an army of men enlisted to do service not only for their respective communities but in the aggregate for the State as a whole, results must come.

The work of making examinations and giving advice on forestry matters has grown even beyond our expectations. The correspondence has been very much larger, but more readily handled, due to the available literature published last year and this.

The continued hearty co-operation and cordial assistance heretofore rendered to the State Forester have not been want-

[1] House Document No. 1290, 1909.

ing this year. After due consideration and study of our forestry needs, some bills were presented before the last General Court which met with approval and were enacted. As on similar occasions heretofore, the forestry interests at the hearings before the Legislature were represented by all our forestry and agricultural organizations, and by public-spirited citizens. In fact, I do not believe I am over-stating conditions when I say that Massachusetts citizens generally are in accord in requesting you, the General Court, to enact as many laws as are necessary to regulate and establish a sane and practical system of forest management throughout this Commonwealth.

New Legislation.

The new legislation enacted by the last General Court on forestry matters was as follows: —

I. Reforestation act.

II. Forest fire protection act.

III. Revised Law on exemption of reforested lands from taxation.

IV. A resolve authorizing the sale of certain publications of the State Forester.

I. Reforestation Act.

The enactment of the bill on reforestation, introduced by Senator Treadway, marks the beginning of a practical demonstration of forest planting throughout the State. This work, it is believed, will prove not only of great economic importance, but be a great factor in practically demonstrating what can be actually accomplished. There is very little excuse henceforth for those of us who own run-out or cheap lands not to make use of them, as the State is ready to meet us more than half way.

The act is as follows: —

THE FIRST GANG TO BEGIN PLANTING.—They are working under the reforestation law of Massachusetts, November, 1908, at South Ashburnham. Several hundred acres will be set next spring.

Acts of 1908, Chapter 478.

An Act to provide for the Purchase of Forest Land and for Reforestation.

Be it enacted, etc., as follows:

Section 1. For the purpose of experiment and illustration in forest management and for the purposes specified in section seven of this act, the sum of five thousand dollars may be expended in the year nineteen hundred and eight, and the sum of ten thousand dollars annually thereafter, by the state forester, with the advice and consent of the governor and council, in purchasing lands situated within the commonwealth and adapted to forest production. The price of such land shall not exceed in any instance five dollars per acre, nor shall more than forty acres be acquired in any one tract in any one year, except that a greater area may so be acquired if the land purchased directly affects a source or tributary of water supply in any city or town of the commonwealth. All lands acquired under the provisions of this act shall be conveyed to the commonwealth, and no lands shall be paid for nor shall any moneys be expended in improvements thereon until all instruments of conveyance and the title to be transferred thereby have been approved by the attorney-general and until such instruments have been executed and recorded.

Section 2. The owners of land purchased under this act, or their heirs and assigns, may repurchase the land from the commonwealth at any time within ten years after the purchase by the commonwealth, upon paying the price originally paid by the commonwealth, together with the amount expended in improvements and maintenance, with interest at the rate of four per cent per annum on the purchase price. The state forester, with the approval of the governor and council, may execute in behalf of the commonwealth such deeds of reconveyance as may be necessary under this section: *provided, however,* that there shall be included in such deeds a restriction requiring that trees cut from such property shall not be less than eight inches in diameter at the butt.

Section 3. The state forester may in his discretion, but subject to the approval of the deed and title by the attorney-general as provided in section one, accept on behalf of the commonwealth gifts of land to be held and managed for the purpose hereinbefore expressed. A donor of such land may reserve the right to buy back the land in accordance with the provisions of section two, but in the absence of a provision to that effect in his deed of gift he shall not have such right.

Section 4. Land acquired under the provisions of this act shall be under the control and management of the state forester, who may,

subject to the approval of the governor and council, cut and sell trees, wood and other produce therefrom.

SECTION 5. All moneys received by or payable to the commonwealth or any one acting on its behalf under the provisions of this act shall be paid into the treasury of the commonwealth.

SECTION 6. Land acquired under the provisions of this act and subsequently reconveyed under the provisions of sections two or three shall not be exempt from taxation on account of any plantation of trees set out or planted while it was held by the commonwealth.

SECTION 7. For the purpose of assisting in reforestation a portion, not exceeding twenty per cent of the money authorized by this act to be expended may be used by the state forester for the distribution at not less than cost of seeds and seedlings to land owners who are citizens of the commonwealth, under such conditions and restrictions as the state forester, subject to the approval of the governor and council, may deem advisable.

SECTION 8. The state forester shall replant or otherwise manage all land acquired by the commonwealth and held by it under the provisions of this act, in such manner as will, in his judgment, produce the best forest growth both as to practical forestry results and protection of water supplies.

SECTION 9. All acts and parts of acts inconsistent herewith are hereby repealed.

SECTION 10. This act shall take effect upon its passage. [*Approved May 1, 1908.*

As above indicated, this bill was approved May 1, 1908, and, as the planting season begins as soon as the frost leaves the ground in the spring, we were unable to make use of the appropriation until later in the year.

In order to bring the enactment to the attention of our people, and to make the first year's appropriation go as far as possible, the following general letter was sent out to all the chairmen of the boards of selectmen of our towns, newspapers, agricultural organizations, women's clubs, etc.: —

DEAR SIR: — The recent General Court enacted a law authorizing the State Forester, subject to the approval of the Governor and Council, to establish a system of forest reserves for promoting the forestry interests of the Commonwealth of Massachusetts (chapter 478, Acts of 1908).

The amount appropriated for this year is $5,000, and succeeding years, $10,000 annually.

In order to make the appropriation as useful as possible, I am

addressing the chairman of the board of selectmen in each town, also all organizations and persons likely to be interested, asking if they have any lands they desire to turn over to the State for forest demonstration purposes. As many acres have already been offered to the State, provided the State Forester will accept and reforest them, and as it is believed that there are many more that would do likewise, I take this opportunity to bring the matter to your attention, and through you to your board, town and public interests.

Should your town authorities neglect to take advantage of this offer, you undoubtedly have some live, enthusiastic organizations, such as the grange, village improvement societies, farmers' and mechanics' clubs, etc., or even one or more public-spirited citizens, who would gladly donate cheap lands for the purpose. The donations for consideration are to be in the following classes: (1) land offered to the State free without restrictions; (2) land offered to the State free with restrictions.

As the work of reforestation thus done is to serve as an object lesson educationally, the State Forester desires in so far as possible to ultimately have these demonstrative forestry experiments in various representative sections of the State, locating them on frequently travelled roads, where they may do the most good.

Should you find an interest in your town to take this matter up, please advise me. It is desired that this work be gotten well in hand, so that all plans may be matured and the definite arrangements made where this work is to go forward.

Only a limited appropriation is available, and if you care to have your town do something, please take the matter up at an early date and confer with me.

It is believed much good is to come from this work, in promoting a better utilization of our waste and neglected lands, that should and will produce valuable forest products when properly husbanded.

When your application is received, it will be filed, and as soon as a date can be arranged, the State Forester or his authorized agent will meet with you or your committee and go over the land to complete arrangements for accepting and planting the same. First come, first served!

Very sincerely yours, F. W. RANE,

State Forester.

STATE HOUSE, BOSTON, MASS.

The outcome of this agitation has resulted in the State's taking over by the end of the fiscal year, Nov. 30, 1908, 882 acres of land and purchasing about a million and a half of seedlings and transplants. We also planted about 25 acres to white pine at South Ashburnham this last fall.

The above work exhausted our first appropriation, and we are now prepared to begin the work of reforestation in earnest, as soon as the frost leaves the ground in the spring.

During this winter we are planning our next year's campaign, and already have many tracts of land in view in various sections. In order to take these lands over, besides an examination as to their suitability for reforesting, much time is necessary to make the necessary survey and transfer of the title to the State.

Of the 1,000 acres turned over to the State thus far, only 160 acres have been purchased, the remainder simply being deeded to the State at no expense. In nearly every instance the owners have inserted the repurchasing clause, so as to regain the property within ten years.

Lands acquired by the State.

Up to the present the State Forester has deeds in his possession from the following towns: —

Town.	Acres.	Town.	Acres.
Andover,	40	Oxford,	20
Ballardvale,	60	Rowley,	100
Barre,	50	Sandwich,	40
Belchertown,	10	South Ashburnham,	100
Carver,	5	Spencer,	75
Dunstable,	20	Templeton,	107
Erving,	40	Westford,	40
Gardner,	64	Westminster,	120
Hubbardston,	54	Winchendon,	50
Montague,	26		932

In this work of reforestation it is my plan to utilize the local forest wardens whenever practicable, of course under proper State supervision, and thus in time the State will have a corps of reforesting experts.

One hundred thousand Scotch pines have been shipped to Sandwich and heeled in this fall, for use in planting on the Cape next spring.

AN ABANDONED MASSACHUSETTS FIELD.—Nature is trying to reforest; man can assist, and quick results will follow.

Of course this work is but in its infancy, but it is believed that our people generally will appreciate this forward movement, and as soon as they realize the generous offer on behalf of the State they will be quick to accept the assistance offered.

With our depleted, neglected and waste lands reharnessed and made a live factor throughout Massachusetts, one of our natural resources will be headed in the right direction. In one town a prominent business man said that the agitation and taking over of lands by the State for reforestation have increased valuations of farming property fully 15 per cent already. If this is true, it must follow that when actual results are shown, the benefits are bound to be still greater.

II. Forest Fire Protection.

This act is bound to accomplish good results. One of the greatest drawbacks to a stalwart progressive movement in forestry is the destruction and wanton waste caused by fires.

The time has come when the towns throughout the State must give a reasonable degree of assurance to their citizens that they are to be protected against losses by fire, if they expect people to invest time and money in reforestation and to build up a proper forest policy.

The following law was enacted in order to regulate and lessen forest fires everywhere. Here is an opportunity for the towns to clothe their forest wardens with power to accomplish results. If all our public-spirited people will give this law proper consideration, and accept the permit clause at the spring annual town elections this year, forest fires are bound to decrease. It is not the purpose of the law to take away personal liberties, but to provide regulations for the benefit of the common good. Our towns throughout this State will be in the future what we make them. The following is the act: —

Acts of 1908, Chapter 209.

An Act to provide for the Protection of Forest or Sprout Lands from Fire.

Be it enacted, etc., as follows:

Section 1. In a town which accepts the provisions of this act or has accepted a corresponding provision of earlier laws no fires shall

be set in the open air between the first day of April and the first day of December, except by the written permission of the forest warden: *provided,* that debris from fields, gardens and orchards, or leaves and brush from yards may be burned on ploughed fields by the owners thereof, their agents or lessees, but in every case such fire shall be at least two hundred feet distant from any forest or sprout lands, and shall be properly attended until it is extinguished. The forest warden shall cause public notice to be given of the provisions of this section, and shall enforce the same. Whoever violates the provisions of this section shall be punished by a fine of not more than one hundred dollars, or by imprisonment for not more than one month, or by both such fine and imprisonment.

SECTION 2. The provisions of the preceding section shall not apply to fires which may be set in accordance with regulations and methods approved by the superintendent for suppressing the gypsy and brown tail moths.

SECTION 3. The state forester shall notify every town in the commonwealth of the passage of this act by sending at least three printed copies thereof to the town clerk, who shall post the same in conspicuous places.

SECTION 4. The state forester and forest warden may arrest without a warrant any persons found in the act of setting a fire in violation of any provision of this act.

SECTION 5. The selectmen of every town shall cause this act to be submitted to the voters for their acceptance at the next annual meeting of the town after the passage of this act. The vote shall be taken by separate ballot, and shall be "Yes" or "No" in answer to the following question printed upon the ballot: "Shall an act passed by the general court in the year nineteen hundred and eight, entitled 'An Act to provide for the protection of forest or sprout lands from fire' be accepted by this town?" A majority vote of the legal voters present and voting at such meeting shall be required for the acceptance of this act; and upon such acceptance the provisions of section twenty-four of chapter thirty-two of the Revised Laws shall cease to apply to any town which has previously accepted that section. [*Approved March 14, 1908.*

III. THE REVISED LAWS ON EXEMPTION OF REFORESTED LANDS FROM TAXATION.

The old law (R. L., c. 12, § 6) required that in order to get planted lands exempt from taxation at least 2,000 trees must be set to the acre. As 1,200 trees is the number commonly recommended, or 6 by 6 feet, this revision was necessary. The new revision also allows the filling out of naturally stocked lands, so that they may receive similar

exemption. This ought to encourage some renewed efforts in that direction. The following is the act: —

ACTS OF 1908, CHAPTER 120.

AN ACT RELATIVE TO THE TAXATION OF PLANTATIONS OF CERTAIN VARIETIES OF TREES.

Be it enacted, etc., as follows:

Chapter twelve of the Revised Laws is hereby amended by striking out section six and inserting in place thereof the following: — *Section 6.* Land upon which pines, chestnuts, larches, spruces, hemlocks, walnuts, hickories, American and large-toothed poplars, yellow and paper birches, beeches, maples, basswoods, or ash timber trees, or others when approved by the state forester, have been set out or planted to the number of not less than six hundred per acre, and which by such setting out or planting has become evenly stocked with such trees to the number of not less than twelve hundred per acre, including in such number the trees growing naturally upon said land, shall be exempt from taxation for a period of ten years after the said trees have grown in height two feet on the average, upon satisfactory proof by the owners to the assessors of the foregoing facts: *provided,* that at the time when the trees are planted or set out the said land is not woodland or sproutland, or land containing more than six hundred standing trees to the acre, and does not exceed in value ten dollars per acre; and *provided, further,* that such exemption shall not extend beyond the time during which said land is devoted exclusively to the growth of said trees. [*Approved February 25, 1908.*

IV. AUTHORIZATION FOR THE SALE OF CERTAIN PUBLICATIONS OF THE STATE FORESTER.

Certain publications of this officer were so much in demand that to meet the same would be a financial burden, and as many of those desiring the publications expressed a willingness to pay for them if it were possible, the following resolve has been passed, enabling the State Forester to sell certain publications at cost, when sanctioned by the Governor and Council. The following is the resolve: —

ACTS OF 1908, CHAPTER 121.

RESOLVE TO AUTHORIZE THE SALE OF CERTAIN PUBLICATIONS OF THE STATE FORESTER.

Resolved, That such publications of the state forester as shall be designated by the governor and council may be sold by the state

forester at a price not less than the cost thereof; and additional copies may be printed for sale at the discretion of the governor and council, the expense thereof to be paid from the receipts from such sales. Any amounts received from such sales shall be paid into the treasury of the commonwealth. [*Approved June 1, 1908.*

Many of the publications have been sent to other States since this resolve was passed. Upon its passage the following letter was sent to all applicants, and new editions have been printed: —

Dear Sir or Madam: — Your application for either or both of the following forestry publications has been received: —

(1) "The Commercial Forest Trees of Massachusetts: how you may know Them. A Pocket Manual." For general use.

(2) "The Study of Trees in Our Primary Schools." For teachers, mothers, and all interested in teaching children to love trees and nature.

Under the Resolves of 1908 (chapter 121), the Governor and Council have designated that these publications be sold by the State Forester at a price not less than the cost thereof; and additional copies may be printed, the expense thereof to be paid from the receipt of such sales.

I am empowered to offer the above-named publications to you at the following prices: —

(1) The Pocket Manual, "The Commercial Forest Trees of Massachusetts: how you may know Them," for 5 cents a copy at this office, or by mail for 2 cents extra.

(2) "The Study of Trees in Our Primary Schools," for 12 cents, or by mail 8 cents extra.

In case a large number are wanted, as for schools, etc., they can be forwarded by express.

These publications are neatly gotten up, and, as they are in great demand (the first edition of 5,000 being exhausted in ten days), charging for them at cost is the only feasible method of dissemination.

I am sorry to have kept you waiting, but pleased to say I am able to supply you or your friends with as many as you may care for, as the new edition has just been received.

Very truly yours, F. W. Rane,
State Forester.

State House, Boston, Mass.

MASSACHUSETTS FOREST LAND. — Reduced to desert conditions by repeated fires; remedy, stop possibilities of fires and replant.

Examination of Woodlands, and Practical Assistance given Owners.

The policy of this office in giving assistance to owners of woodland in this State has been continued during the past year, with very satisfactory results. This assistance consists in an examination and report to the owner on the condition of his woodland or potential woodland, and advice looking to the treatment of the same. This advice, other than travelling expenses, is given free to the land owner.

The examinations made in 1908 number 64, outstripping the record of all previous years. The highest previous mark was 47 in 1906, while last year they numbered 37, — an increase of 67 per cent. The acreage is 15,842, — an increase of 86 per cent over that of last year.

Four of these examinations were what are called working plans; that is, the land was surveyed, and a forest map accompanied the report. The written outline included an estimate of the amount of standing timber, its value, the improvement work advised, its cost and the probable results. Two of these were made for private parties, one on a tract of 250 acres and one on a tract of 400 acres. The *chef-d'œuvre* of the year was a forest working plan for the city of Fall River, which covered the watershed of North Watuppa Pond, the city's water supply, — an area of more than 5,000 acres. The city owns 3,000 acres of this land. The fourth working plan is for the town of Westfield, and covers the watershed of their supply in Granville, some 6 square miles. Only the field work of this plan has so far been completed.

These working plans made on the watersheds are not alone useful to the communities for which they are made, showing them how they can handle the lands in their possession to the best advantage, but offer a basis for the study of the effect of forests on water flow. The working plan gives the character of the watershed, its area and the amount of forested and nonforested land. The controlling boards are usually in possession of figures which give the yield of the ponds and streams which constitute the supply. After a number of watersheds of different character have been

studied, some useful comparisons can be made from the accumulated data, and perhaps light thrown on a subject which has not been studied to the extent that one of such importance should be in this country.

A certain amount of "booming" was given to this phase of the work by sending out circular letters to the various State institutions, 15 in all; 5 of these took advantage of the offer and sought advice in regard to their woodland. Circular letters were also sent to the water supply authorities in the various cities and towns, and 5 have asked for examinations; other boards have asked for assistance.

Results of Assistance for 1907.

Blanks were sent to 25 people who received examinations last year, the object of which was to find out how far the recommendations made were carried out. Concerning the other 12 of the 37 the office was in possession of information which made the sending of blanks unnecessary. It was hoped also that this sign of interest in the work of last year would stir up those that have done nothing.

A summary of the results of this investigation is as follows: out of 37 examinations, 17 were recommended to thin, 20 to plant, 3 to do nothing, and 4 have no cards on file. Of those recommended to thin, 3 did all the work and 6 did part of it; this leaves 8 who have done nothing, or have not reported, which we imagine is much the same thing. On the planting side, 2 carried out all the work as advised, and 10 did something; the remaining 8 did nothing, or have not reported.

From the results of the work as reported for previous years, and from experience gained during the past year, we come to the following conclusions: —

1. That planting excites more interest and is more readily taken up than thinning.
2. That thinnings are increasingly important, as the work of fighting the gypsy moth becomes more widespread.
3. That thinning work is much more likely to be carried out if the trees to be cut or left are marked by the visiting forester.

4. That elaborate working plans and maps, when made for private parties, result in nothing more being done than would come from an ordinary examination and report, and so should be abolished except in certain cases, when they should be made at the expense of the owner.

5. That, if this co-operative work increases during the present year at a rate approaching that of the last, it will be impossible for one man to accomplish it, so that another technical forester to help in this and other work will be a necessity in the office.

The New Application Blank for Examinations.

In order to simplify matters, and thereby get a larger number of our people owning woodlands acquainted with the willingness on the part of the State to assist them, the following new blank was printed and distributed very generously: —

No......... Received.....................

APPLICATION FOR AN EXAMINATION OF FOREST LANDS TO THE MASSACHUSETTS STATE FORESTER, STATE HOUSE, BOSTON.

The State Forester stands ready at all times to promote the perpetuation, extension and proper management of the forest lands of the Commonwealth, both public and private (1904, chapter 409, section 2).

If you have such lands, and desire an examination of them and advice as to their management, fill out the following blank form and send it to the above address of State Forester.

Upon receipt, this request will be placed on file, and you will be informed, in order of application, approximately when the examination can be made, and a mutual date can then be decided upon.

The only expense the applicant promises to pay is that of travel and subsistence of the State Forester or his assistants, incurred in making the examination.

It is always more satisfactory to personally meet on the property the owner or party most interested, at least when the preliminary examination is made. In this way a definite understanding can be had as to future undertakings, and whether working plans are necessary. Often a preliminary visit to gain knowledge of the problem and give advice on the grounds are all the services needed.

When sending this application in, a brief description of the land will assist us.

With the above understanding, I desire to have an examination made of a tract of land of approximately.........acres, located in the town of................, county of................, State of Massachusetts.

Signed..........................
Address........................

Date........................., 19 .

In order to emphasize the willingness on the part of the State Forester to co-operate with all State institutions in doing forestry work on any land that might belong to them, the following letter was addressed to the superintendents or officials, as the case might be, and a copy of the application enclosed: —

My Dear Sir: — I desire to call your attention to one of the duties of the State Forester, that is, the examination of lands belonging to any citizen or institution in the State, and the giving of professional advice in regard to its treatment for forestry purposes. There is no charge to the recipient of this advice except the necessary expense of travel and subsistence. This offer applies equally to land now under tree growth or unimproved land that should be.

A great many citizens have availed themselves of this offer, but very few institutions have made any applications for assistance under this law. It is more than probable that you know nothing of this opportunity, and it is for the purpose of acquainting you with it that this letter is sent.

Public institutions which have theoretically at least a permanent existence, are in a better position than private persons to carry on work which requires several years to show results. The State has established this office to bring about improvement of the present wooded area and the reforestation of unproductive land. It should lead the way by carrying out work on its own property.

If your institution has under its charge any wooded or unimproved land, I hope that you will make application to this office for a preliminary examination, after which, if the area is large and the work complex, a complete working plan can be made.

We are very busy at the present time, and cannot take up this work immediately, but if we have it in mind, will be in a position to take it up as rapidly as possible.

Very truly yours, F. W. Rane,
State Forester.

THE SAWDUST PILE TELLS THE STORY.—This land should be immediately planted to white pine.

Forest Nursery.

The State forest nursery at Amherst on the farm of the Agricultural College was somewhat enlarged last spring, and, although it has been a very dry season and we had no facilities for watering the beds, they have come through in good shape. We have a stand of white pine, one-year-old seedlings, that is estimated will give over a million trees for future use. Smaller stands of other species of evergreens and deciduous trees are also growing here. This work is self-supporting, and in no instance have trees or seeds been given away.

As in the case of last year, particular pains were again taken this year to assist all persons having had planting examinations made, so that practical results would follow. In this way many plantations were made that otherwise would have remained unplanted.

It is believed that the State can well afford to do even more in nursery work. Commercial nurseries are asking higher prices, and as the demands are constantly increasing and we shall need larger supplies in the future, there can be no mistake in our growing enough to partly supply this demand. When commercial forest nurseries have been in existence long enough, so that we can depend upon getting stock at practical planting prices, we shall not need to do as much. There is a great difference in being able to save from $1 to $3 an acre in the first cost of planting, when seedlings are used. When transplants are used, the price is relatively higher.

The following orders were sent out last spring from Amherst: —

Name.	Address.	Quantity of White Pine.	Quantity of Ash.	Amount.
Prof. J. Tyler,	Amherst,	1,000	–	$4 00
John A. Cox,	East Brewster,	1,000	–	4 00
Wm. W. Colton,	Dalton,	2,000	–	8 00
Overseers of the poor,	Palmer,	1,000	–	4 00
N. D. Bill,	Springfield,	–	10,000	45 00
C. H. Thayer,	Hadley,	1,000	–	4 00
Paul C. Rockwood,	Ashburnham,	2,000	–	8 00
G. P. Morse,	West Wareham,	1,000	–	4 00
G. W. Wheelwright,	Wheelwright,	5,000	–	20 00
C. L. Hutchins,	Concord,	5,000	–	20 00
C. A. Codman,	Dedham,	10,000	–	40 00
Mrs. L. P. Howe,	Boston,	1,000	–	4 00
Lawrence Minot,	Wareham,	4,000	–	16 00
G. W. Cook,	Barre,	3,000	–	12 00
G. D. Johnson,	Andover,	1,500	–	6 00
E. A. Bowen,	Lakeville,	5,000	–	20 00
Dr. J. E. Briggs,	Segregansett,	2,000	–	8 00
R. E. Allen,	Shrewsbury,	1,000	–	4 00
Kennan Damon,	Concord,	7,000	–	28 00
H. S. Cheney,	Southbridge,	5,000	–	20 00
A. G. Brockwalter,	North Wilmington,	1,000	250	5 00
H. M. Killam,	Georgetown,	1,000	–	4 00
E. C. Parker & Co.,	West Acton,	5,000	–	20 00
L. C. Patterson,	Webster,	5,000	–	20 00
F. S. Clark,	Pittsfield,	200	200	1 65
A. F. White,	East Freetown,	1,000	–	4 00
S. I. Bailey,	Hanover,	1,000	–	4 00
B. S. Blake,	Auburndale,	2,000	–	8 00
Taunton Water Works,	Taunton,	4,000	–	16 00
P. R. Bradbury,	Norwell,	2,000	–	8 00
E. A. Hall,	Cambridge,	2,000	–	8 00
W. P. Bailey,	Wareham,	5,000	–	20 00
G. F. Kenney,	Brimfield,	1,000	500	6 25
E. P. Sherburne,	Roxbury,	–[1]	–	1 00
A. C. Spafford,	Bradford,	1,000	–	4 00
Lawrence Park,	Groton,	1,000	–	4 00
Sanborn G. Tenney,	Williamstown,	1,000	–	4 00
E. P. Williams,	Buckland,	1,000	–	4 00

[1] School order.

Name.	Address.	Quantity of White Pine.	Quantity of Ash.	Amount.
Baker Box Company,	Worcester,	1,000	–	$4 00
E. E. Earl,	West Boxford,	1,000	–	4 00
S. D. Charles,	Brooks,	2,000	–	8 00
E. H. Blanchard,	Lindenwood,	1,000	333	6 00
E. G. Childs,	Bondsville,	3,000	1,000	16 50
P. F. Leland,	Holliston,	2,000	–	8 00
H. T. Brockway,	South Hadley,	500	–	2 50
S. E. White,	Winchendon,	1,000	–	4 00
Wm. A. Gaston,	Barre,	3,000	–	12 00
H. L. Frost,	Arlington,	–	3,000	13 50
A. R. Sharp,	Taunton,	–	3,000	13 50
H. L. Frost,	Beverly,	–	2,000	9 00
Park Hill Manufacturing Company,	Fitchburg,	5,000	2,000	29 00
A. L. Hyde,	Southbridge,	800	200	4 50
C. R. Stacey,	Taunton,	–[1]	–	1 00
P. R. Allen,	Walpole,	–	500	2 25
E. A. Smith,	Lowell,	1,000	–	4 00
H. L. Frost & Co.,	Walpole,	–	700	3 15
E. W. Breed,	Clinton,	–	2,500	11 25
B. S. Blake,	Auburndale,	1,000[2]	–	1 50
Total,		115,000	26,183	$578 55[3]

[1] School order. [2] Wild seedlings.
[3] This amount was turned over to the State Treasurer.

The following larger orders, for purchasers for whom examinations and recommendations for planting were made, were shipped direct from commercial nurseries: —

Name.	Address.	Quantity.
Mt. Hermon School,	Mt. Hermon,	85,000
Nathan D. Bill,	Springfield,	20,000
Wm. G. Nickerson,	Dedham,	20,000
A. R. Sharp,	Taunton,	50,000
Everett Flood,	Palmer,	10,000
Brockton Water Works,	Brockton,	30,000
N. I. Bowditch,	South Framingham,	10,000
P. M. Low,	Baldwinville,	10,000
Total,		235,000

White Pine Seed.

Name.	Address.	Quantity (Pounds).	Amount.
G. W. Wiggin,	Boston,	1	$2 00
N. D. Bill,	Springfield,	25	43 75
C. H. Bonney,	Boston,	3	6 00
O. C. Cook,	Milford,	1½	3 00
F. S. Clark,	Fitchburg,	¼	50
G. C. Tanski,	West Brookfield,	1	2 00
O. L. Howlett,	Southbridge,	1½	3 00
F. C. Hartwell,	Littleton,	1	2 00
E. S. Magoon,	Barre Plains,	1	2 00
F. M. West Company,	Springfield,	2	4 00
H. E. Hildreth,	Harvard,	2	3 50
O. H. Skinner,	Harvard,	½	1 00
G. E. Stone,	Amherst,	1	1 75
Total,		40¾	$74 50[1]

[1] This amount was turned over to the State Treasurer.

As stated in last year's report, it has been our purpose to see that all persons for whom examinations are made should be assisted directly in getting practical results. One way in which we served to accomplish this last spring was to furnish the seedlings at cost, and what we were unable to furnish from the State nursery were purchased and sent to them.

Nursery Stock on Hand in Fall of 1908.

VARIETY.	Age (Years).	Quantity.
White pine seedlings,	2	150,000
White pine seedlings,	1	1,200,000
Pitch pine seedlings,	1	40,000
Norway pine seedlings,	2	25,000
White ash seedlings,	1	20,000
Chestnut seedlings,	1	5,000
Black locust seedlings,	1	10,000
Honey locust seedlings,	1	12,000
Boxelder seedlings,	1	30,000
Horse chestnut seedlings,	1	100
		1,492,100
White pine transplants,	3	40,000
White ash transplants,	3	500
Catalpa speciosa transplants,	2	1,000
Maple transplants,	2	1,000
Oak transplants,	2	500
Total,	. . .	1,535,100

Seed on Hand in Fall of 1908.

	Pounds.		Pounds.
White pine,	175	Balsam fir,	2
Pitch pine,	5	White oak,	10 [1]
Red pine,	2	Chestnut,	25 [1]
Hemlock,	2	White ash,	10
Red spruce,	2	Black ash,	10
Norway spruce,	2	Rock maple,	30

[1] Bushels.

MUNICIPAL FORESTS.

One of the interesting features of the year was the spontaneous development of an important field of endeavor in forestry undertakings that has come in for a large share of the time of the State Forester's office.

Just at a time when we were planning and hoping for the establishment of more permanent forest reserves, Mayor Coughlin of Fall River, together with his water commissioner and city engineer, called at the office in an official capacity to determine if the State could assist them in converting their water basin about Watuppa Pond into a forest, the suggestion having come to the water commissioner when reading an article which appeared in one of the Boston Sunday papers, on the State Forester's work. The results of this meeting were that the State Forester and his assistant spent a day with the Fall River city officials, made a preliminary report, which was accepted, and then a working plan of the whole watershed, which covers an area of over 3,000 acres, exclusive of the reservoir itself. This work will appear as a publication from this office later in the year.

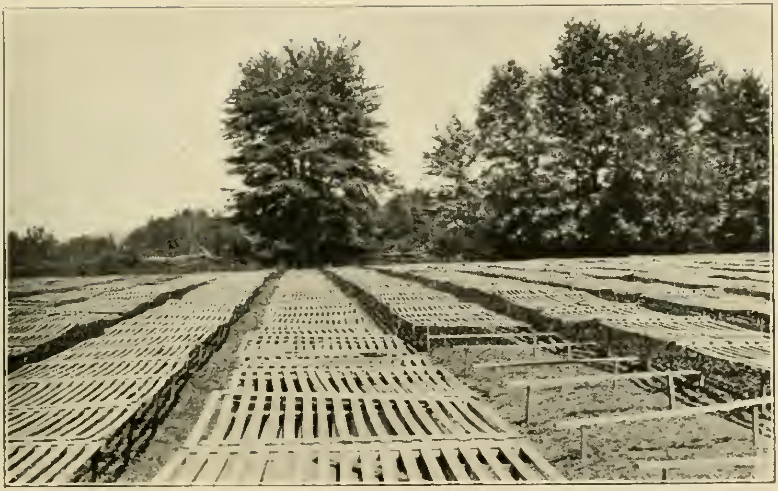
Upon learning of the work at Fall River the town of Westfield applied for a similar examination and plans for its watershed. This report is in progress at the present time.

Seeing that the work would be of equal interest to many other cities and towns, the State Forester wrote all such, with the result that at the present time we have applications on hand for several more, and this department of the office can see plenty of work ahead of it for some time. It may be said that the cities in each instance have been ready to turn over to the State, for its assistance, the help of its engineers and assistants, so that the expense to the State remains relatively low for this work.

The beauty of this work is that, from whatever standpoint one cares to look at it, it is found to be a great benefit. Practically or economically, æsthetically or from the sanitation standpoint, the city is bound to derive great future benefit.

Public Lectures and Addresses.

The State Forester has done all this kind of work he possibly could, and keep up with the routine work necessary under the present organization. During the winter months one's whole time could be utilized largely in lecture work on forestry, the demands are so great. As heretofore, the policy has been to accept invitations to address public meetings



State Forest Nursery at Amherst. — Over 1,000,000 white pine seedlings at end of first year.

whenever it can be shown that good results are likely to follow. In accepting invitations, the request is made that an audience of at least 100 be guaranteed, if possible.

Lectures before Business Men's Organizations.

One of the pleasing features of the year was the great interest manifested in forestry by our various boards of trade, merchants' associations, lumbermen's organizations, etc. The State Forester delivered talks on forestry before such organizations in the cities and towns of Fitchburg, Pittsfield, North Adams, Springfield, Winchendon, Bridgewater, Upton, Clinton, and several in Boston, as the Massachusetts Reform and Economic clubs, Lumbermen's and Market Gardeners' associations. Results of these meetings have been very apparent in the great amount of inquiries and requests that have come to the office from this source. It takes business men to do things, and to these organizations the State Forester looks for very much assistance in the future.

Lectures outside the State.

The State Forester has been called upon to address various organizations during the year outside the State, some of which were: the Society for the Protection of New Hampshire Forests, at Intervale, N. H.; the Citizens of St. Johnsbury, Vt.; the Society for the Promotion of Agricultural Science, at Washington, D. C.; the American Forestry Association, Washington, D. C.; and the University of Maine, at Orono, Me.

The National and State Conservation Commissions.

The State Forester was chairman of the State delegation appointed by Governor Guild to attend the Conference of Governors, called together by President Roosevelt last May. Later the same committee of three was appointed as the State Conservation Commission, to assist the National Conservation Commission in getting together data relative to the natural resources of the nation. Of course the office of the Massachusetts commission was in collecting Massachusetts data only. This same State commission, headed by Governor

Guild, attended the second meeting of the National Conservation Commission in Washington, D. C., during the week of December 8.

The National Irrigation and Forestry Congress.

The State Forester was invited to address the above congress at Albuquerque, N. M., September 29 to October 4, on "Municipal Corporation and Private Ownership Forestry Development."

This congress was as usual a very representative occasion, and offered a splendid opportunity to meet men who are doing things. To the acquaintances made at this meeting and that of last year at Sacramento, Cal., are due the interest and courteous treatment given us by western men at the recent hearing before the agricultural committee of Congress at Washington, D. C., the fore part of this month, at which Governor Guild presided. Governor Chamberlain of Oregon, Ex-Governor Pardee of California and President-elect Barstow of the National Irrigation and Forestry Congress, who were in attendance at the Conference on the Conservation of Natural Resources at the time, all prominent in said Irrigation and Forestry Congress, gladly appeared and endorsed our movement for the White Mountain and Southern Appalachian forest reserves.

As alluded to last year, the more one sees of the more arid sections of the west, the better satisfied he is with the future possibilities of New England forestry.

Meeting with the State Firemen's Associations.

One of the pleasing occurrences of the year was the opportunity offered through an invitation of the State Firemen's Association to address that body on "Forest Fires and their Prevention," at their annual meeting which convened at Nantucket on September 9 and 10. Not only was the State Forester well received and given an exceptional opportunity to get acquainted with the men who have in charge the great responsibilities of protecting our homes in our cities and towns, but he was able to discuss with these men the impor-

tance of also systematizing and working out similar methods for handling forest fires.

Since attending this meeting and making the acquaintance of so many good men, a great many valuable suggestions and assistance have come to the office; and there is little doubt but that as time goes on very valuable assistance is bound to come from the chiefs of fire departments in regulating and organizing forest-fire fighting methods for effective results.

Our forest wardens and the chiefs of fire departments and their deputies should by all means work together in harmony. Already in many instances both offices are held by one man. Where the offices are separate, a definite understanding and methods of co-operation should be entered into. Both are public servants, and should be public spirited and work together for the benefit of all.

Pine Tree Blight.

There probably have been few subjects that have caused more alarm than the so-called pine tree blight, which was so prevalent last year, and is still in evidence, although to a far less degree, this season. As was predicted in last year's report, the trouble was not as prevalent this year, especially in sections where it was very bad last year, as at Winchendon. However, at Greenfield it was worse, if anything. On the whole, for the State, while trees affected last year still showed the effects, and an experienced person could pick them out at a distance, nevertheless they have improved in condition, and many will undoubtedly outgrow this malady.

In order to keep in close touch with the pine tree blight, so that, should it develop still further this season, we might possibly obtain further information for combating it, besides having the assistants and others on the alert for developments, a young man, Mr. Thomas Jones, a recent graduate of the Massachusetts Agricultural College, who had specialized in mycology, was employed for a month. Nothing particularly new was found, other than was reported in the annual report last year.

Early in the season most of the tip growth of the new shoots seemed to be affected, and it was thought that some

young plantations of trees from three to six feet high at Winchendon were more troubled than last year; but a month later it was found that the browning or dying did not extend beyond the first stage, and when the needles were fully out the general appearance was little else than normal.

Undoubtedly more or less white pine trees will be affected from year to year with this trouble; but it is believed that we need to pay little attention to it, other than when a tree is badly affected and is going to die, it should be cut and utilized. The greatest loss comes where pine trees are valued from the æsthetic or landscape-gardening standpoint; and these are not as likely to be troubled, as the chances are they are on better soils, and hence likely to withstand such depredations.

Forest Fires.

The past season has been a noted one throughout the country for disastrous forest fires. The extremely dry season rendered conditions exceptionally favorable for fires throughout the whole summer season. Exceptionally heavy forest fire losses were reported constantly from all the New England States, New York, Canada and the Lake States.

This is the first year Massachusetts has ever had a definite system whereby reliable data on forest fires have been collected. We are not in a position, therefore, to compare this year's data with those of previous seasons, other than in a general way. The State Forester takes pride, however, in reporting that it is his belief that Massachusetts has suffered relatively less than other States, considering her dense population and previous experiences. When Maine and the Adirondacks and other New England States were having their worst fires, Massachusetts was comparatively free.

It is believed that our new forest warden system saved to the State this year alone far more than people begin to realize. The State Forester has kept one man busy throughout the year, simply attending to the new forest fire regulations and assisting the forest wardens.

During the first part of the season forest warden badges were decided upon, which are numbered consecutively from 1 to 350, and sent out to all wardens. This has assisted,

Portion of State Forest Nursery at Amherst. — Showing transplant beds.

in that it gives the warden his proper credentials. The number of each badge is kept on file in this office, and thereby any forest warden can be identified. The badges are the property of the State Forester, and held by the wardens only during their services as such.

As alluded to elsewhere, warning forest-fire notices, made of cloth, were supplied to all wardens in large numbers; and they and their deputies took great pains in seeing that these were posted generally throughout the towns, and particularly where there was slash remaining from cut-over lands, etc.

During the very smoky times this office was repeatedly informed from the various wardens that they were exerting themselves and keeping close watch, and even patrolling the towns to minimize the great chances for fire outbreaks. No one could expect a greater loyalty and interest than these newly appointed forest wardens and their deputies have shown, and the State Forester desires here to publicly acknowledge their true worth and fidelity to the State.

It is proposed to publish the data collected on forest fires for the State in a bulletin by itself, a little later on. The following table will be of interest, in showing to what extent and number and of how great damage these fires have been during the year. It may be said also that these fire estimates may be considered extremely conservative. Can any one doubt the needed rational legislation for handling such a parasite upon our veritable future prosperity?

	Unknown.	Locomotive.	Farmers burning Brush.	Smokers.	Set by Boys.	Hunters.	Berry Pickers.	Miscellaneous Causes.	Totals.
Forest wardens' reports, number of causes,	337	539	96	111	58	18	11	209	1,379
Reports returned, with damages,	$58,200	$23,800	$15,100	$23,000	$2,700	$5,400	$1,800	$42,600	$172,600
Damages on reports received too late for tabulation by months.	$14,736	$4,138	$2,900	$5,000	$800	$1,600	$700	$7,274	$37,148
Damages estimated on burned area where no figure was returned.	$17,479	$4,369	$2,913	$5,040	$800	$1,603	$700	$7,492	$40,396
Total damages,	$90,415	$32,307	$20,913	$33,040	$4,300	$8,603	$3,200	$57,366	$250,144
Burned area in which damage was reported, by acres,	23.4% 6,491	13.8% 3,840	14.2% 3,958	18.6% 5,163	3.4% 957	3.4% 957	6.4% 1,796	16.8% 4,578	27,740
Burned area in which no damage was reported,	1,638	966	994	1,302	238	238	448	1,176	7,000
Burned area not tabulated by months,	-	-	-	-	-	-	-	-	4,596
Total area reported as no damage,	-	-	-	-	-	-	-	-	991
Total acreage reported,	-	-	-	-	-	-	-	-	40,327

Forest Fire Posters.

Following the instructions in the statutes, as last year, the State Forester had the abbreviated instructions of the forest fire laws printed on a large paper poster in red and black ink, 18 by 27 inches in size, and distributed them to all railroad stations, post-offices, chairmen of the boards of selectmen and forest wardens. For general use a new, smaller and more practical cloth poster was sent out in large quantities to all forest wardens for use throughout the State. This poster has served its purpose well, and good reports come from every section, which shows our people are taking an interest in stopping forest fires. (See below.)

WARNING!

FOREST FIRES

EXTRACTS FROM MASSACHUSETTS FOREST LAWS.

1. **Setting Fire to Growing Wood or Timber of Another.** Punishable by a fine of not more than $100.00 or by imprisonment for not more than six months. R. L. 208, Sec. 7.

2. **Letting Fire Escape.** Negligently allowing fire to escape from your own land to adjoining land. Punishable by a fine of not more than $250.00, also liable for damages. R. L. 208, Sects 8 and 9.

3. **Forest Wardens Not Liable to Arrest for Trespass.** Wardens, Deputies and Assistants, not liable for trespass while acting in the reasonable performance of their duties. Acts 1907, 475, Sec. 6.

4. **Permit to Light Fire in the Open.** In Towns so voting. A permit from the Forest Warden must be obtained to start a fire **between April 1 and December 1.** The only exception being—that debris from fields, gardens and orchards, or leaves and brush from yards may be burned on ploughed fields by the owners thereof, their agents or lessees, but in every case such fire shall be at least two hundred feet distant from any forest or sprout lands, and shall be properly attended until extinguished. Violation of this provision—Punishable by a fine of not more than $100.00 or imprisonment for not more than one month or by both such fine and imprisonment. Acts 1908, 209, Sec. 1.

5. **Arrest without Warrant.** The forest warden may arrest any persons found in the act of setting a fire in violation of the provisions of this act. Acts 1908, 209, Sec. 4.

6. **Penalty for Refusing Aid.** Any person between the ages of 18 and 50 years who refuses, without good cause, to assist the Forest Warden or his deputies in the fighting of forest fires is liable to a fine of not less than 5 or more than 100 dollars. R. L. 32, Sec. 21; 1907, 475, Sec. 3.

7. **Disturbing Notices.** Whoever wilfully tears down or destroys any notice posted under the provisions of this act shall be punished by a fine of $10.00. Act 1907, 475, Sec. 7.

Posted by authority of Acts 1907, Chap. 475, Sect. 2. **F. W. RANE,** State Forester,
State House, Boston, Mass.

Forest Mensuration of the White Pine in Massachusetts.

The above was the title of a publication of this office sent out during the year. The purpose of the publication was set forth in its preface, "Reasons for Publication," as follows: —

This handbook is published by the State Forester that our people in Massachusetts may have at their disposal information as to how they may determine, by simple measurements and the use of tables, the yields, and hence the values, of pine trees, from the commercial or lumberman's standpoint.

The time has come when we should have a better practical working knowledge of forest values. Forest products continue to become more valuable yearly. It is believed that business men and all persons at all interested in forestry matters, as well as lumbermen and farmers, can get much that is of value from the tables and general information contained in this handbook. There is no reason why a person owning white pine growth, whether a small or a large tract, should not be able to determine practically how much lumber it is capable of producing, and hence its value, even before the trees are cut, if he cares to do so. This handbook will assist him in doing this very thing.

Trees are easy of access, and can be estimated with great accuracy. The old idea, that a man must spend a lifetime as an estimator or cruiser in order to determine accurate yields from tree growth, is rapidly passing. The time of guesswork is being replaced by more definite knowledge.

In order to secure the data contained in the tables, the State Forester has had measurements of white pine taken in all parts of Massachusetts by trained men, and the data have been submitted to practical experts as well, so we feel the work is authoritative.

This publication has been well received and apparently much appreciated.

Good Roads a Benefit to Modern Forestry.

The forward movement and excellent work being carried out in road construction throughout Massachusetts are bound to result in bringing about modern forestry management in many back rural towns, more quickly than many people realize. The farther the forests are from the railroad or mar-

ket, the greater the expense made necessary in operating them. If to disadvantage in distance poor roads be added, it is readily seen that the transportation question alone precludes practising modern forestry. The fact that two to three times as large loads can be drawn on good roads as on poor ones, and in many instances more trips can be made in the same length of time, will convince any practical lumberman or business man of the importance of good highways.

The State Forester is under many obligations to the State Highway Commission for courtesies extended during the year to study the State forestry conditions, by being invited to accompany said commission on their inspection tours, which were made by automobiles.

The Tenth Anniversary of the Biltmore Forestry School.

The State Forester was the Massachusetts delegate appointed by Governor Guild to attend the tenth anniversary of the Biltmore Forestry School.

This occasion, which occurred at Biltmore, N. C., November 26, 27 and 28, on the estate of George W. Vanderbilt proved a most instructive and valuable one. As the "American Lumberman" expressed it, "An Extraordinary Outing of Representatives of all concerned with Timber, from the Tree to the Trade." The three days were extremely well planned by Dr. C. A. Schenck, the head of the Forestry School, for getting just the information desired. There were representative men present from every phase of forestry interests and from all over the country, including Canada.

It was an excellent opportunity to see just what can be accomplished in forestry in a comparatively short time, and also to have pointed out and discussed wherein failures have been made.

This occasion marked a new epoch in American forestry, and, without giving further details about the gathering, suffice it to say that the anniversary proved extremely instructive and valuable, from a great many standpoints. The State Forester felt well repaid for the trip.

Co-operation with the United States Forest Service and Forestry Officials of Other States.

The State Forester wishes here to acknowledge the hearty co-operation that Mr. Gifford Pinchot and his able assistants and forestry officials of the various States have rendered whenever called upon. At the present time co-operative work with the division on forest products of the forest service is going forward, which we believe will prove of great value when finished. This will require some little time yet. It has been a pleasure to be of assistance to the many forest service men who have been compiling data of various sorts for the National Conservation Commission reports throughout the season. The State Forester welcomes all interested in forestry.

Articles for Papers on General Forestry Information.

During the year there were calls upon the State Forester for some general literature for use in interesting owners of woodland in a few sections. This call came first from an enterprising newspaper man and a lumberman at Greenfield. Thinking the information would be of equal use to all rural sections, articles were prepared from time to time and sent to all papers that could use them to advantage. These articles were used quite generally, and we believe have been of assistance to many. Four of the articles sent out were as follows: —

How may the Farmer assist in the Reforestation of New England?

Forestry, when managed properly, will utilize our millions of acres of land in New England, at present seen on all too many farms scattered in every section, known as waste land, abandoned pastures, sprout lands, barrens, plains, etc., returning them to forest culture.

If modern agriculture has taught us farmers anything, it is that concentration of effort, better culture and modern rotations are what make profitable farms. If an inventory is taken of the average New England farm, it will be found that there are many acres capable of yielding more profit to the farmer if devoted to the forest or

tree crop than used for any other purpose. These acres should therefore be converted to forestry as rapidly as possible. If each farmer will act accordingly, it may be only a matter of a comparatively short time when New England would be blessed with well-balanced rural conditions. The State Forester, agricultural colleges and forestry schools of various New England States are ever ready to assist and advise in forestry work.

The same culture that will return saw logs to our mills, make work for our country folk in winter, replenish our town treasuries, repaint the old red schoolhouse, pay the sexton to again ring the country church bell, make better roads, and, in short, return the former substantial livelihood of country life, will also conserve moisture, protect and enrich the soil, give an equitable climate, and return to New England the natural beauty we all would love so much to see.

This is a seed year for the white pine in Massachusetts, and it may be elsewhere. Let each farmer collect some cones before they open, which is very shortly, then extract the seeds and plant them next spring in a bed in the garden. In two years' time he will have enough seedlings, if they are properly cared for, to set out many acres. We must learn to plant and care for our forest lands in the same way we do our better tillable soils, and they then will bring proportional yields of profit. The beauty of the whole forestry problem of New England is that in its practical solution it not only results in economic forestry, but solves the æsthetic side as well. It is entirely wrong to think that trees should never be cut. Lumbering is as important to successful forestry as is the digging of potatoes or the harvesting of any crop when it is ripe. The same essentials of culture, also, must be understood in getting maximum returns in the one case as in the other.

F. W. RANE,
Massachusetts State Forester.

HOW TO COLLECT AND USE WHITE PINE SEED.

White pine seeds sell at $4.50 retail, $2 in large lots, in Boston this summer, and the seeds of some other evergreen trees are still higher. Every owner of woodland with matured pines is in a position to take advantage of these almost fabulous prices, for the time has arrived when the pine cones should be picked. The white pine cones containing the seeds are ripe, and should be picked at once. This dry weather will open the cones before many days, and the seeds will drop out and scatter to the four winds, almost a total loss, while prudent lumbermen all over the country are paying high prices for seeds picked elsewhere. The market has to be supplied; it fixes a price that will produce the goods. If the seeds cannot be obtained at $4.50 per pound, they will go higher, until the farmers go into the business of seed picking or give away their prospects to

commercial pickers. Moreover, the revival of interest in forestry is so marked in Massachusetts this year that it points to reforestation on a broad scale in the near future, and this will be attended by an increasing demand for the white pine seed. Tree owners who are alive to their prospects will prepare for this demand by saving this year's crop, since the white pine seed will retain its vitality for several years, if given normal conditions, — not too moist or excessively dry.

There is no time to lose this year, nor time to make elaborate preparation for systematic picking. Collect the seeds somehow, by the means that first suggest themselves, and the market will turn them into cash. One way is to run a long ladder up the tree; another is to go into the sections where lumbering is going on, and collect the cones as the trees are felled. Boys may climb up with small bags thrown over their shoulders and pick from the large branches without difficulty, about the same as apples are picked. After the cones are gathered, they may be dried where squirrels and mice are kept from them, and then thrashed until the seeds fall out. The practice of using a bag to put cones in is convenient, as they may be flailed in the bag during spare moments, and the seeds fall out where they are readily separated from the waste.

To turn this waste crop into ready cash is not the only inducement in store for the land owner. It makes reforestation so comparatively inexpensive, producing the seed at the cost of cheap labor, instead of at $4.50 per pound, that there no longer will then be good reason for allowing waste land to remain idle and non-productive. Under its new policy the State of Massachusetts gives direct aid and counsel to any land owner who desires to seed his waste land. Communication on this subject may be established with the Massachusetts State Forester, Prof. F. W. Rane, State House, Boston, and he will be pleased to meet the farmers and to give practical advice. He says that of the vast amount of lumber used in Massachusetts probably 95 per cent. is imported from other New England States, from the west and from the south. Massachusetts certainly is capable of growing more than 5 per cent. of the lumber it uses; in fact, it is destined to become a lumber State that will closely approximate its consumption with its production, and the production of a seed crop at reasonable cost is the first important step in this movement.

An Opportunity to reforest Waste Lands.

Reforestation is so vital to Massachusetts and to her country population that it will be placed on a systematic basis in the near future. Preparations are now being made, under authority of an act of the Legislature of 1908, appropriating $5,000 for this year and $10,000 annually thereafter. With this money the State proposes to buy and reforest idle land, and has already addressed itself on the subject

A Pine Stand at Plymouth marked for Thinning.

The Same Stand after Thinning.

to the selectmen and land owners throughout the Commonwealth, with most promising results.

The proposition is arousing attention everywhere. Hundreds of acres of waste land have been offered to the State at nominal cost, a considerable portion of it being offered as a free gift. Such overtures have come from West Brookfield, Spencer, North Ashburnham, Hubbardston, West Tisbury, Westford, Sharon, Gardner, Oxford, Winchendon and Sandwich. A business concern has pledged itself to donate 100 acres of land in southern Massachusetts, and an individual in Hampshire County has come forward voluntarily with an offer of 300 acres. This movement among land owners to turn over their idle property to the State, brisk at its very inception, substantiates the general supposition that there is in Massachusetts a vast acreage of land that has become unprofitable through indiscriminate and unbusinesslike lumbering. It shows, further, that the owners of this property have lacked the incentive, or the means, or the inducement, to tie up their capital on soil where the returns are so remote. Now comes their opportunity to let public capital develop their land and restore it to a paying condition on better terms than private effort could do; and many of them are quick to see that this is a wise policy, even if it takes away conditionally their title to the property. On these terms the State is getting a wide choice of land, and when it has registered enough to permit of proper selection, the actual work will begin. There seems to be no doubt now about the ability of the forest department to get all the land it can handle.

While the deed in these transactions passes the land over to the State, it provides that the original owner may repurchase within a stipulated period, at the price he received plus the money spent on improvement and 4 per cent. interest. In all probability the replanting can be done by the State at less cost than by private effort, because the State has the work reduced to a science, and a corps of trained men to execute it. Not only are individuals accepting this proposition, but townships have taken it under consideration, with a view to turning over to the State sections of poor farms and watersheds for the planting of trees.

Both in accepting free and in buying land, the State will give preference to tracts situated along highways, where the new plantation may serve the dual purpose of restoring the lumber stock and demonstrating to the public how the work should be done.

The Collection and Use of Other Forest Tree Seeds than White Pine.

Now is the time to collect certain forest tree seeds. One crop of the forest is gone, — the white pine, — and another is ready for the harvest. In years gone by the pine seed has been wasted in Massachusetts; it was wasted this year, too, but it attracted more attention

than in the past, and the reports from various parts of the State show that more was collected than is usual. For instance, a man in Winchendon has collected 100 pounds of clean seeds this fall, employing boys to pick the cones for him, and he netted at least $100 on the job. Massachusetts could be made to supply its own seed for reforestation, and it is squandering a valuable product so long as it does not. The rebuilding of our forests is of such vast importance that it is the first subject to be taken up at the conference of New England Governors soon to be held in Boston. Land owners have an excellent opportunity this fall to provide themselves with the seeds of hardwood trees, such as the white ash, the rock maple, the hickory, the chestnut and the beech tree. The picking should begin at once, and it should be completed before the second week in November.

On the white ash, for example, the leaves have fallen off and the seed remains on the tree; they are about two inches long, and are provided with wings, hence are easily seen and reached. A medium-sized tree, about as large as an ordinary apple tree, may yield about 20 pounds of seed, retailing at about $1 per pound. Almost any other crop of equal value would be taken care of, but this one, as a rule, is allowed to go to the winds. It can be harvested into a bag without much difficulty, either by shinning the tree or raising a ladder. There is a good demand for white ash. The seed of the rock maple has about the same commercial value; it is easier to gather, because the limbs on the tree hang low, and it will remain on the tree two or three weeks longer. How to keep the seeds of the white ash and the rock maple over winter is a problem that requires some attention, but it is not difficult. It is only necessary to dig a hole in the ground some feet deep and sink a box into it; in the bottom of the box put a layer of sand, and then spread a layer of seed 5 inches thick; cover this with 2 to 3 inches of coarse sand, and repeat the layers until the box is filled or the supply exhausted. Then cover the box about 1 foot deep, to prevent the contents from freezing, and the stock will keep until next April, when it should be taken up. Kept thus during the winter it is ready for planting in the spring, and should be set half an inch deep in rows about 1 foot apart. In one year the plants will be large enough to transplant to the forest where they are to remain.

The first substantial frost will open the burrs on the white oak, the chestnut, the hickory and the beech, and the seeds will drop to the ground, where they can be picked without any difficulty. The acorn is worth about $2 a bushel, the chestnut 15 cents a quart and the hickory nut $3 per bushel. They are layered for the winter in the same way as the white ash and rock maple, and in case of only a small quantity the most serviceable method is to sink a 2-foot tile into the ground and fill it with layers of sand and nuts, stretching a

wire netting over the top, to keep the squirrels out. The pitch pine and Norway pine cones will open almost any time, and should be picked at once, before they open, if this year's crop is saved. The Massachusetts State Forester is aiding in every possible way to accomplish results; let us all do our part.

The following very complete and valuable work accomplished by the Metropolitan Water and Sewerage Board in practical forest planting is published in this, the State Forester's report, by permission of said Board, in order that the data may be put into the hands of our people, who will find it of great value in demonstrating definite results: —

Forestry Work in Connection with the Construction of the Wachusett Reservoir.

In order to treat comprehensively the work as it has been carried on, it will be found advantageous to divide the subject into five branches, namely: general; nurseries; plantings; improvement thinnings; fire protection.

General.

The work of reforestation was begun in 1898 by the preparation of two nurseries for the raising from seeds of both coniferous and deciduous seedlings, to be planted on such of the lands owned by this Board as were not already covered with a timber stand of some description.

The first field planting was made in the spring of 1902, when about 175 acres were planted, and since that time plantings varying in size from 50 to 200 acres have been made every spring and fall.

The results obtained have been exceptionally satisfactory as far as the conifers are concerned, there being approximately 90 per cent. of the seedlings planted which have lived.

The deciduous seedlings raised in the nursery have in almost every case failed completely after being transplanted into the field. This failure was probably due to the character of the soil in the nursery.

Altogether, there have been planted about 1,330 acres with about 1,850,000 trees, made up of 948,000 conifers and 902,000 hardwoods, of which about 90 per cent., or 853,000 conifers, and 7 per cent., or 63,000 hardwoods, are living at present.

Nurseries.

There are two nurseries, one on either shore of the reservoir, having an aggregate area of 8 acres.

The one on the north shore, containing 4.3 acres, is used for hardwood or deciduous seedlings, and was originally arable or grass land,

so that no great amount of preparation was necessary to make this area suitable for nursery purposes.

The one on the south shore, containing 3.7 acres, is used for the raising of coniferous seedlings. This area was originally covered with a white oak and chestnut stand about fifteen years old, so that a large amount of work, consisting of clearing, grubbing, plowing and harrowing was necessary to prepare the area for nursery uses. This work cost about $200 per acre.

The nursery work, which consists of preparing the ground, sowing the seed, caring for the seedlings by watering, mulching, screening and weeding the first year, and transplanting, watering, screening and weeding the second and third years, costs $1.50 per 1,000 trees for the first year and $1.60 per 1,000 trees for each succeeding year.

Plantings.

The seedlings, having been at least two seasons in transplant rows, are now ready for their final planting into the field. Planting gangs composed of from 25 to 30 men are employed on this work, 4 or 5 of whom are engaged in the nurseries preparing the trees for the field, which work involves taking the trees from the transplant beds, pruning the roots, sorting, counting, puddling and transferring to the field, while the remainder are engaged in the actual planting process. The maximum rate of planting acquired by an experienced gang under ideal conditions was 1,000 trees per man per nine-hour day.

Spring plantings are made immediately after the frost leaves the ground, and fall plantings before it enters.

Previous to the fall planting of 1906 the general type of planting was white pines, spaced 10 by 10 feet, with some hardwood filler, making the trees 5 feet apart each way. The above-mentioned type was abandoned in 1906 because of the almost complete failure of the hardwoods, and solid white pine stands, the trees spaced 6 by 6 feet, have been planted since that time.

In order to have an effectual screen along the forested portions of the shore of the reservoir, which would prevent the foliage from the deciduous trees from being blown into the reservoir, three rows of white pines, spaced 6 feet apart each way, and two rows of arbor vitæ, 2 feet apart, trees 3 feet apart in the rows, have been planted on the back half of the 50-foot reservoir margin. The greater proportion of the arbor vitæ have failed, probably because of having been planted in the field when too young (two or three years old) to endure the severe exposure which prevails along the shores of the reservoir.

Improvement Thinnings.

Under ideal conditions the trees require no care after having been planted in the field; but experience has shown that in pasture or brush land, where the common gray birch grows naturally, and in

sprout or scrub land which has been underplanted, it is necessary to thin out and trim up the hardwoods in order to prevent too much shade and the destructive thrashing of the tops of the pines. This process, termed "improvement thinning among planted trees," costs about $6 per acre.

In the original timber stands the policy has been to take out the mature, undesirable or weak trees, thereby improving the stand by giving more space and air to the strong, hardy specimens. This class of work costs about $20 per acre, but there is a considerable revenue from the wood cut, which in some cases has been sufficient to make the work pay for itself.

Fire Protection.

Among the greatest dangers to the forests are fires, and in order to prevent their spreading to or from abutting property, and to provide a line of defence on which to fight them, a fire guard 40 feet wide has been cut around the entire outside limit of the marginal lands of the reservoir. There is also a network of forest roads 15 feet wide throughout the reservation, which acts as supplementary fire protection. The brush and weeds are cut from these two protective systems once every year.

A double furrow has been plowed along that portion of the fire guard where there was no stone wall, to check the advance of creeping fires from neighboring property.

On holidays and Sundays, during the dangerous seasons of the year (early spring and late fall), men armed with fire extinguishers patrol the reservation to further protect it from the ravages of forest fires.

Thus far no serious fires have occurred, though several have started which would have caused great damage but for the effectual protection given.

Table of Work accomplished to Jan. 1, 1909.

Total area of nurseries (acres),	8
Total area planted (acres),	1,330
Total number of trees planted: —	
Coniferous,	948,000
Deciduous,	902,000
Total length of reservoir margin planted (miles),	32
Total length of fire guard cleared and maintained (miles),	20.8
Total length of forest roads cleared and maintained (miles),	30
Planted area thinned (acres),	488
Original timber stands thinned (acres),	209

Table of Costs (Wage Rate, $1.75 per Eight-hour Day).

Nurseries: —	
Clearing nursery on south shore,	$200 00 per acre.
Maintenance of nursery, first-year seedlings,	1 50 per 1,000 trees.
Maintenance of nursery, second and third year seedlings,	1 60 per 1,000 trees per year.

Plantings: —	
Clearing areas preparatory to planting, .	$4 00 per acre.
Transplanting seedlings from nursery to field, ...	5 20 per 1,000 trees.
Transplanting seedlings from nursery to field, ...	5 50 per acre (6 by 6 feet planting).
Improvement thinnings: —	
Among planted trees, ...	6 00 per acre.
In original timber stands, . . .	20 00 per acre.
Fire protection: —	
Clearing marginal fire guard 40 feet wide, .	150 00 per mile.
Maintaining marginal fire guard, . .	27 00 per mile per year.
Clearing and grading forest roads 15 feet wide, ...	120 00 per mile.
Maintaining forest roads, . . .	8 00 per mile per year.
Maintaining fire patrol, ...	95 00 per year.

Reforestation. — Summary of Costs (Wage Rate, $1.75 per Eight-hour Day).

Items.	Per 1,000 Trees planted.	Per Acre planted.
Preparing nurseries, ...	$0 40	$0 56
Seedlings (one year), ...	1 50	2 09
Transplants (two years), ...	3 18	4 42
Preparatory clearing, ...	2 88	4 00
Field planting, ...	5 20	5 50
Clearing 40-foot fire guard, ...	76	1 06
Clearing 15-foot forest roads, ...	1 00	1 35
Maintaining 40-foot fire guard (per year), ...	14	19
Maintaining 15-foot forest roads (per year), ...	06	09
Maintaining fire patrol, ...	02	03
Improvement clearing, ...	4 30	6 00

The foregoing table shows that it costs $14.92 per 1,000 trees, or $18.98 per acre (1,390 trees per acre), to raise the trees from seed, prepare, plant and protect the lands planted through the time of the final planting in the field; that it costs $0.22 and $0.31 per year respectively to maintain efficient fire protection; that it costs $4.30 and $6 respectively for an improvement thinning, which will probably have to be made twice during the first ten years, after which time the trees should care for themselves.

Yours very truly,

Henry H. Sprague,

Chairman.

E. R. B. Allardice, superintendent in charge Wachusett department; Dexter Brackett, chief engineer of water works.

Assistants.

The assistants and employees of the State Forester have practically remained the same throughout the year, and it is a pleasure to compliment them on their fidelity and earnest endeavors in promoting and advancing the State work.

Mr. H. O. Cook, M.F., has done valiant service, particularly in technological lines, as contained in the publication "Mensuration of White Pine," in numerous examinations, etc.

Mr. R. S. Langdell, who has charge of the nursery work and is assisting greatly in the reforestation work, is ever hustling and giving splendid satisfaction, as the nursery and reforestation reports show.

Expenditures and Receipts.

In accordance with section 6 of chapter 409 of the Acts of 1904, as amended by the Acts of 1907, chapter 473, section 2, the following statement is given of the expenditures for the year ending Nov. 30, 1908: —

Salaries of assistants,	$3,318 55
Travelling expenses (not included in co-operative fund),	678 89
Stationery and other office supplies,	379 30
Printing,	2,209 78
Postage,	711 99
Express,	175 40
Instruments,	11 34
Miscellaneous,	89 25
Nursery,	2,361 73
	$9,936 23
Balance unexpended,	63 77
Total appropriation,	$10,000 00

Reforestation Account.

Seedlings,	$3,495 79
Express,	597 73
Travelling,	61 35
Land,	759 00
Tools,	82 58
	$4,996 45
Balance unexpended,	3 55
Total appropriation,	$5,000 00

There was realized from the sale of seedlings $578.55, and for seeds $74.50, total $653.05, which amount has been turned over to the Treasurer and Receiver-General; there was also received from the sale of publications $153.83, which has also been turned in to the Treasurer and Receiver-General, making a grand total of $806.88. If to this amount is added the amount unexpended, $67.32, we have $874.20 as a credit for the year.

In accordance with section 5 of the above-named chapter, the following statement is given of the receipts for travelling and subsistence: —

Lectures.

Jamaica Plain Unitarian Church, Jamaica Plain,	$1 02
Fitchburg Merchants' Board of Trade, Fitchburg,	5 00
The Thursday Club, Brookline,	55
Merchants' Association, Pittsfield,	10 50
North Adams Merchants' Association, North Adams,	9 91
Women's Club, Clinton,	2 00
Farmers' Institute, Ashfield,	9 70
Worcester Grange, Worcester,	3 00
Farmers' Club, Franklin (paid by club).	
Wellesley and Needham Farmers' and Mechanics' Club, Wellesley,	1 00
Winchendon Citizens, Winchendon,	5 00
State Board of Education, Lunenburg,	4 93
Bridgewater Commercial Club, Bridgewater,	3 50
Waban Women's Club, Waban,	–
Pomona Grange, Foxborough,	2 25
Women's Club, Wellesley Hills,	56
Institute of Technology, Boston,	85
Warren Grange, Warren,	4 80
Village Improvement Society, Marion,	2 50
Women's Club, Lynn,	50
Yarmouth Camp Meeting, Yarmouth,	3 00
Cochituate Grange, Cochituate,	1 00
Springfield Pomona, Wilbraham,	4 75
Beverly Improvement Society, Beverly,	1 00
Sunderland Grange, Sunderland,	4 50
Farmers' Association, Upton,	2 50
Westwood Grange, Westwood,	2 97
Board of Trade, East Bridgewater,	2 00
Pomona Grange, Berlin,	2 50
Pomona Grange, Westfield,	5 50
South Weymouth Grange, South Weymouth,	75

Marlborough Grange, Marlborough,	$2 50
Beacon Club, Waban,	–
Women's Club, Norwood,	75

A list of the visits made, the area of woodland involved and the receipts for expenses are as follows: —

Examinations of Woodlands.

Name of Owner.	Town.	Area (Acres).	Expense.
Aberthaw Construction Company,	Phillipston,	211	–[1]
Allen, Philip R.,	Walpole,	2	$1 60
Bridgman, H. F.,[2]	Shirley,	15	3 05
Bryant, E. A.,	Dover,	75	60
Bates, Gen. A. E.,	Windsor,	1,000	5 00[3]
Bartlett, G. M.,	Templeton,	80	2 50
Bird, C. S.,	Walpole,	60	60
Beebe, Miss E.,	Wilbraham,	400	1 80[3]
Cole, E. E.,	Scituate,	6	–[1]
Hospital School,[2]	Canton,	65	1 10
Dennison, H. S.,	Framingham,	100	1 00
Dunbar, E. P.,	West Bridgewater,	8	90
Edwards, George,	Middleborough,	100	1 25
Edson, C. F.,	Wilbraham,	35	–[4]
Fisher, L. N.,	Walpole,	7	10
Farnsworth, R. M.,	Lancaster,	150	1 75
Fall River Reservoir Commission,	Fall River,	3,000	52 85
Griswoldville Manufacturing Company,	Colrain,	100	4 90
State Colony for Insane,	Gardner,	600	2 90
Hall, A. N.,	Dunstable,	25	1 30
Hall, A. H.,	Leominster,	3	–[4]
Hayward, E. L.,	Easton,	4	1 00
Harvey, W. A.,	Dover,	160	–[1]
Holton, S. S.,	Lexington,	40	30
Holyoke Water Board,	Holyoke,	2,500	6 70
Howe, L. P.,	Bolton,	7	3 50
Hudson Water Board,	Hudson,	30	1 00
Hutchins, Rev. C. L.,	Concord,	25	80
Kilburn, W. G.,	Lancaster,	7	1 80
King David Lodge,	Taunton,	17	1 65
Leland, E. F.,	Andover,	200	6 00

[1] Paid by owner. [2] Made two visits. [3] Part expense. [4] No expense.

Examinations of Woodlands — Concluded.

Name of Owner.	Town.	Area (Acres).	Expense.
Leominster Water Board, . .	Leominster, . . .	40	$1 70
Lyman, R. W., . . .	Belchertown, . . .	50	1 00 [1]
Means, Rev. O. W., . . .	Brookfield, . . .	250	2 70
Medfield Insane Asylum, . .	Medfield, . . .	–	1 10
Payson, W. E., . . .	Norton, ...	3	1 20
Pease, Miss Laura, . . .	Middleborough, . .	25	– [2]
Plymouth Water Board, . .	Plymouth, . . .	40	– [2]
Randall, C. A., . . .	North Dana, . . .	30	– [2]
Rutland Sanatorium, . .	Rutland, . . .	100	2 10
Seaver, Allyn, ...	Wilbraham, . . .	127	1 80 [1]
Sedgwick, Alexander, . .	Stockbridge, . . .	300	6 00 [1]
Snow, R. K., ...	Wayland, . . .	30	60
Stevens, Chas., . . .	Sudbury, . . .	5	1 25
Stone, C. A., ...	Plymouth, . . .	200	1 50
Symmington, R. B.,[3] . .	Plymouth, . . .	10	3 20
Thayer, R. P., ...	South Hadley, . .	80	2 00 [1]
Walpole High School, . .	Walpole, . . .	20	– [2]
Westfield Water Board, . .	Granville, . . .	1,000	20 00
Worcester Insane Colony, . .	Grafton, . . .	500	1 70
Whitney, W. M., . . .	Winchendon, . . .	175	2 65
School for Feeble-minded, .	Waltham, . . .	45	– [2]
School for Feeble-minded, .	Wrentham, . . .	15	1 20
Wyman, H. A., . . .	Lakeville, . . .	400	1 60
Lawrence, Dr., . . .	Lexington, . . .	20	40
Dean, Wm. M., . . .	Taunton, . . .	200	– [2]
Sharp, A. R., ...	Taunton, . . .	600	– [4]
Pittsfield Water Board, . .	Pittsfield, . . .	1,500	– [4]
North Adams Water Board, .	North Adams, . .	125	– [4]
Prince, F. H., ...	Wenham, . . .	800	– [4]
Prescott, C. W., . . .	Concord, . . .	70	– [4]
Burgess, J. K., . . .	Dedham, . . .	50	– [4]
Total area, . . .	. . . . .	15,842	–

[1] Part expense. [2] No expense. [3] Made two visits. [4] Paid by owner.

A Stand of White Pine at Sudbury, Mass.—This was a field only partly planted by filling in the blank or open spaces when young; now about thirty-eight years old, and estimated to cut 38,000 feet B. M. per acre. One thousand feet per year of white pine is a fair return from cheap lands. Stumpage is worth $7 to $10 per thousand.

What the General Court is asked to consider at Present.

I. To amend the Reforestation Law, so that the State Forester may not be limited to purchasing Forty Acres in Any One Tract.

While, of course, the purpose of the law in stipulating the number of acres was to spread the work out broadly and make it an object lesson of educational value, nevertheless there are often many tracts that exceed this acreage, and it is but natural that the whole tract should be handled at the same time, and thereby much more economically. Where a few acres overruns the stipulated number, it requires an extra survey, and adds greatly to the expense as well in making out the transfer papers. This amendment would be of great assistance in the practical working out of this law.

II. A State Forest Survey.

To authorize a forest survey of the State, in order to determine just what lands should be retained in forests, as an economic factor of the State's conservation policy. With a definite knowledge of conditions mapped out, the State Forester will be greatly aided in the work of reforestation, and have a guide to future endeavor in State work. The survey could be carried out in connection with the working plans department of the State Forester's office, by simply appropriating a certain amount for employing assistance to do the work. Another way of handling the project would be for the State to pay one-half of the expense of such a survey, provided the counties pay one-half. This work need not be accomplished in one year, but taken up in a systematic way, spending only a nominal sum each year until it is finished.

Our people realize the great importance of conserving the forests in the White Mountains and southern Appalachians, and they undoubtedly recognize equally the importance of conserving the forests within our own State, although they are not on so large a scale.

III. Uniform Forestry Legislation.

It was the consensus of opinion, as the result of the first New England conference called by the Governors of the New England States, that much mutual benefit could come through uniform legislation. Through a call by the Massachusetts State Forester, the New England State Forestry officials met at the State House, Boston, on December 4, and decided to make the following general recommendations for consideration by their respective State Legislatures: —

(*a*) *Resolved,* That the cost of extinguishing fires known to be set by railroads shall be paid for by said railroad corporations.

(*b*) *Resolved,* That when forest fires are caused by individuals, the individuals causing said fires shall be liable for all expense of their extinguishment.

(*c*) *Resolved,* That it is the opinion of the committee that the present Massachusetts forest fire law relative to giving permits for the burning of brush and setting of fires out of doors should be adopted for all the States.

(*d*) *Resolved,* That we believe in legislation to regulate the management of forest lands, and that a permit be required by operators of portable mills from the State forest officials.

(*e*) *Resolved,* That there should be a law in each State, similar to the Vermont law, authorizing the Governor to issue a proclamation, when it is thought advisable by the State forest official, prohibiting sportsmen and others from traversing the woods unnecessarily.

(*f*) *Resolved,* That there should be definite understandings with the railroads and State forestry officials as to the dangerous sections of the railroad lines traversing the respective States, so that patrols by the railroads may be established whenever it is thought advisable by the State.

(*g*) *Resolved,* That there should be a law to regulate the taking of firearms into the woods during the closed season on game.

IV. Increased Appropriation needed.

The State Forester feels it none other than his duty to ask for an increased appropriation for his work this coming year.

If examined carefully, it can be shown that the expenditure for reforestation and nursery work, while in itself an expenditure by the State, must ultimately come back to the

State treasury with interest. This, therefore, eliminates as a real out-go from the State treasury fully one-half of the annual appropriation made for this office.

We are convinced that the enactments passed in recent years are proving their value. Now that we have our corps of 350 forest wardens appointed and in the harness, let us give them every legitimate worthy support possible. With an early convention of the forest wardens, I am sure the results to come from such would be regained financially an hundred fold in a single year. The State Forester could utilize the services of forest wardens in various towns to a great advantage along many mutual lines, were there more funds that would permit it. Where such work is left to the towns, many are likely to be indifferent, while, if awakened by a general current of live endeavor on the part of the State, they catch the spirit and realize the importance of self-preservation. As soon as we have our forest wardens thoroughly familiar with the great good to be accomplished, they are going to impart its importance to the towns they represent.

As I stated last year, the State Forester hopes to so educate his wardens that they will become in a sense town foresters, who shall keep the importance of forestry and how to perpetuate and manage the same practically directly before the people. With such an organization, when gypsy moths, pine blight, fires, etc., are troublesome, or, on the other hand, when people desire to reforest lands or thin and give proper care to their wood lots, in either case here is a man to whom they may look for advice. Is not the State making an expenditure here that will ultimately bring a great reward?

In establishing workable State forest policies, as in every other new undertaking that requires an expenditure of money, we are inclined to be conservative. When we realize, however, that many of our small towns are paying large sums annually simply for fighting forest fires, which expenditure is a constant drain and too often a total loss, to say nothing about the actual loss in present and future forest products, I am sure that business and thinking men can see that it is simply a losing proposition not to definitely and at

once spend a few dollars that will make it possible to save millions in the future.

The State Forester could spend to great advantage in the coming year $25,000 in systematizing and furthering the forestry interests throughout the Commonwealth. Of this sum, $10,000 is already provided for in the reforestation act of last year. The regular appropriation for the running expenses and general work of the State Forester for the past year was $10,000; therefore, the appropriation asked for would be an increase of $5,000.

Summary of Recommendations.

(1) That the reforestation law be amended so as not hereafter to limit the purchases of land to 40-acre tracts.

(2) That a State forest survey be established, and funds for its accomplishment be provided.

(3) That the six resolutions of the New England State forestry officials be considered with a view to their adoption for uniform forestry laws. One recommendation is already in the Massachusetts statutes.

(4) That the appropriation for the State Forester's work be $25,000 for this year, $10,000 of which is already provided for in the reforestation act.

Respectfully submitted,

F. W. RANE,
State Forester.

FIRST ANNUAL REPORT

OF THE

STATE ORNITHOLOGIST.

FIRST ANNUAL REPORT OF THE STATE ORNITHOLOGIST.

To the State Board of Agriculture.

It seems imperative to devote to bird protection this the first report of the State Ornithologist. The study of birds, their habits and food has been carried far enough to demonstrate their economic value, and it now remains to determine how their numbers and usefulness may be increased, and their services practically utilized for the conservation of useful plants.

On April 2, 1908, the State Ornithologist was appointed under an act passed by the Legislature of that year; this report, therefore, records the work of only nine months. In January previous to the appointment of the State Ornithologist many bills for the protection of birds were introduced into the Legislature. Several of these bills failed of passage. Prominent among them was House Bill, No. 507, which provided for a close season on all wild fowl and shore birds from January 1 to September 1. This bill was referred to the next General Court. An act requiring the licensing of all resident hunters was passed, to take effect Jan. 1, 1909. Another, giving deputies or game wardens the right to arrest without a warrant all suspected persons refusing to exhibit their game on demand, was passed. Also, the open season on upland game birds was shortened. The first two acts will tend greatly to help in the enforcement of the laws for the conservation of game and birds; the last will give much-needed protection to the game birds, which at the time of its passage were at a low ebb in point of numbers.

Educational Work.

The educational work of the year has consisted largely of lectures delivered before farmers' institutes, granges and other organizations. Twenty-eight of these lectures were given during the spring and summer, but an accident which temporarily disabled the ornithologist prevented the continuation of this work during the fall.

Publications.

In June three publications of the ornithologist were revised and reprinted. These were: (1) "Birds as protectors of orchards," from a bulletin of the State Board of Agriculture, issued first in July, 1895, third edition; (2) "Two years with the birds on a farm," a lecture delivered at the public winter meeting of the said Board at North Adams, Dec. 2, 1902, second edition; and (3) "The decrease of birds, and its causes, with suggestions for bird protection," second edition. The demand for these bulletins has justified their publication. The special report on "Useful birds and their protection," first published in 1907, passed through two editions in that year, and, as the second edition was nearly exhausted early in the present year, a third edition was issued.

Investigations.

The evident need of better protection for the game birds, wild fowl and shore birds made necessary a further and more exhaustive investigation of the present depletion of these birds, and the causes of their decrease in numbers; this was begun early in the spring by correspondence with naturalists and sportsmen, and by personal interviews with experienced gunners, particularly along the shore. This investigation was continued throughout the summer, and in October a circular letter, requesting information regarding these birds, was printed. This circular is still being sent out to people having a knowledge of the subject. It is hoped that eventually a report may be prepared which will set forth the most effectual methods of conservation, and serve as a basis for legislation.

YOUNG LEAST TERN, ABOUT HALF GROWN. (Photograph from life, by E. H. Forbush, at Chatham, Mass.)

In July several trips were made for the purpose of investigating the condition of certain colonies of gulls, terns, herons, sandpipers and plover along the coast. Some correspondents had alleged that there were still some great blue herons breeding in the State, but no evidence of this was seen. In Barnstable and Dukes counties three large colonies of night herons were found. These birds have decreased greatly within the last twenty-five or thirty years; but one of the colonies is now protected by the owner of the land, and bids fair to remain there for so long at least as this protection continues.

On July 10, 1908, the well-known colony of least terns at Katama Bay was inspected. The terns of New England were so persecuted by the agents of the milliners that at one time these birds were in danger of extinction. The least terns have been more nearly extirpated than any other species, and it is now believed that there are practically no least terns breeding upon the North Atlantic coast of the United States, except those on the coast of Massachusetts. The colony at Katama Bay was generally believed to be the largest left in New England. The birds there evidently are decreasing somewhat; 24 birds were counted there at one time, and there were probably 30 nesting on the beach. Twelve nests were found, with one to three eggs in each, and two young just hatched were seen. Later visits to the same locality gave evidence that many of the eggs had hatched. Natives of the island said that some of these birds are killed while their young are still small, by gunners who legally can shoot on the beach during July and August. Late in the fall the Commissioners on Fisheries and Game appointed a warden at Edgartown, who, it is hoped, will be able to protect the terns on this beach. Visits to many islands and beaches during the months of July and August revealed several other colonies of the least tern, and 173 birds were seen. There are probably at least 200 individuals of the species breeding on the coast and islands of Massachusetts, and they are slightly increasing in numbers. It is hoped that this small remnant of the vast host of least terns formerly breeding on our coasts may be preserved and increased until they reoccupy a large part of the region in which they formerly dwelt.

Under protection the common tern and the roseate tern are multiplying rapidly, and are now attempting to breed again on coasts and islands whence they had been driven by the feather hunters. The following estimate may be given of the numbers found on the principal breeding places: Muskeget Island, 10,000; Penikese, 7,000; the Wepecket Islands, 5,000; Ram Island, 1,200; Gull Island, 700; Skiff's Island, 300. Birds are nesting also in small numbers on several beaches, and it is probable that over 30,000 of these terns are now breeding within the limits of the State.

The laughing gulls, once nearly exterminated, on the island of Muskeget have so increased in numbers that there are now fully 1,000 birds (estimated) in two colonies there. They have colonized on the Maine coast, and are increasing there. They are also visiting other islands, and it would not be surprising if a few were found nesting in other localities in Massachusetts. Even the herring gull, which is not known to breed here, now frequents some of the islands off our coast during the entire year.

The piping plover and the willet, which once bred in numbers along our coasts, were victims of spring and summer shooting. The willet long since entirely disappeared in the breeding season, and the piping plover is well on the road to extirpation. The entire number seen on the Massachusetts coast in July did not exceed 20 birds. Very small birds unable to fly were seen in July and August. The laws of Massachusetts still (December, 1908) allow the shooting of these birds in these months, and with such laws on our statute books, the only possible hope for the salvation of the birds lies in forbidding shooting on their breeding grounds, and enforcing the regulation by means of resident wardens or deputies.

The Increase of Office Work.

The State Ornithologist is now looked upon as an advisory or consulting ornithologist by many citizens of the State, and the correspondence of the office continually increases. This correspondence occupies a large part of the time of the present incumbent, and requires occasionally the services of an outside stenographer. This has made it impossible to do

some of the outdoor experimental work that had been intended. Some of this work should be undertaken the coming year.

The Necessity of Field Work and Experiments for the Increase and Protection of Birds.

The Increase of Insect Pests.

The alarming increase of such introduced pests as the gypsy moth, the brown-tail moth, the San José scale and the elm-leaf beetle continues. Every possible means which may lessen in any degree the multiplication of these pests should be encouraged. Already Congress and the Legislatures of the New England States have appropriated nearly $3,000,000 for the control of the brown-tail and gypsy moths, and probably over three-quarters of a million dollars are now being expended annually by government, States, municipalities and individual land owners, in the attempt to control these insects.

Notwithstanding all this vast expenditure, the brown-tail moth is rapidly increasing and is spreading to the north and east, while the gypsy moth is not fully under control except perhaps in the States of Connecticut and Rhode Island. This statement is made with no intention of criticising those engaged in government, State or municipal work for the suppression of these insects. Doubtless they have done their best; certainly some improvements in methods have been made, which are capable of producing greater results for the money expended than ever before, but the work is not keeping pace with the rise and spread of the insects. When our State work was resumed against the gypsy moth, in 1905, no one knew how far the insect had extended its range during the previous five-year cessation of repressive work by the State. No one knows to-day! The State and government authorities are still inspecting the territory, to learn how far the gypsy moth has been disseminated. We already know that the region now infested in New Hampshire is as large as was the known infested territory in Massachusetts in the year 1900, and that all this New Hampshire infestation occurred after the Legislature of Massachusetts, ignor-

ing the recommendations of the Massachusetts State Board of Agriculture, gave up the work of extermination in that year. Furthermore, it is now evident, to all who understand the habits of these insects, their means of distribution and their rate of increase under favorable conditions that many municipal authorities have been wholly unable to grasp the situation and promptly apply the remedy. Also, the funds supplied by national, State, city and town governments have been absolutely inadequate to prevent the spread of the pest in woodlands.

The time has come when it is no longer possible by human agency to stop this dissemination. Nevertheless, we must continue the fight, and appropriate even larger sums than in the past, for we can in this way hinder the "wrath to come" by checking the rapidity of the dissemination of the gypsy moth along our highways and railroads. But we must face the fact that all the revenue of the United States government will not now suffice to prevent the eventual spread of these insects throughout the forests of New England, and perhaps over a large part of the continent.

In the end we must come to depend more or less upon the natural enemies of these insects, such as meteorological influences, diseases, parasitic and predaceous insects and insectivorous birds and mammals to preserve our forests from destruction by these introduced pests, as they have in the past defended them from the attacks of native species. Our only hope of a final suppression or reduction of these pests in the woodlands lies in a gradual restoration of the biologic balance.

Attempts to breed and introduce parasitic and predaceous insects are to be highly commended. Success may be years in coming, — it may never come; but nevertheless these experiments should be continued indefinitely, with the exercise of the utmost care and skill. Every effort should be made also to protect the birds, upwards of fifty species of which feed on the gypsy moth, the brown-tail moth or the elm-leaf beetle. Experiments should be conducted to attract such birds to localities where their services are most needed, and perhaps to breed such species as may be artificially propagated. It is perfectly feasible to increase the

numbers of useful birds from 200 to 300 per cent. This has been done in this country on a small scale, and in Europe it has succeeded on a large scale; but it is impossible for the State Ornithologist to attempt this on a scale of any economic importance, because of the extremely limited appropriation allotted to his work. If such an attempt is to be made, the means must be furnished by the State superintendent of the moth work, and must come from the appropriation for the suppression of these insects. The possibility of success by this method appears to be fully as great as in the case of parasitic insects, but some years will be required to reap the full benefit of these methods. Also, means might be found to protect such useful animals as bats and toads. They should be protected by law, at least, and it should be the duty of every teacher in our public schools to instruct the pupils regarding the value of insectivorous birds and animals, and to request them not to kill or molest such creatures.

Why Birds do not control the Gypsy Moth.

It is pertinent to inquire here why birds which are efficient checks on the increase of native insects are not so effective in controlling introduced species. It is evident to all that the birds are too few in numbers to cope with both native and introduced insects. The so-called English sparrow, which drove many of the native birds out of the region where the gypsy and brown-tail moths were introduced, is largely responsible for the reduction in the numbers of native birds, and therefore for the unrestricted increase of the insects. It is peculiarly unfortunate that measures undertaken for the wholesale destruction of the gypsy moth, the brown-tail moth and the elm-leaf beetle result in decreasing rather than increasing the number of birds.

As the moths multiply in numbers, we might expect a corresponding increase of the birds that feed upon them; but spraying with arsenical poisons, cutting away the undergrowth and dead limbs and filling up or covering the cavities in trees all operate to reduce the number of birds or to drive them away from infested localities.

Wherever the moths have become extremely abundant

and destructive, they must be counted among the chief enemies of the native birds. They defoliate the trees while the birds have young in the nests. This exposes the young birds to the rays of the summer sun and to the attacks of their natural enemies, with the result that very few birds can be reared in such localities.

For the foregoing and other reasons the decrease in the number of useful birds has been very marked in some of the localities where their services are most needed.

Suggestions for Experimental Work to determine the Practical Value of Birds as Moth Destroyers.

Inasmuch as there are now large tracts of forest lands in the regions infested by the gypsy moth in which very little work for the suppression of the insect can be carried on, owing to the lack of sufficient means, it is suggested that at least two competent men be employed to take measures to attract and protect birds and increase their numbers on certain tracts. It is important also to know whether the titmice, nuthatches or creepers have learned to eat the eggs of the gypsy moth. Apparently they had not learned this during the years from 1895 to 1900, when their feeding habits were watched by the agents of the Board of Agriculture. Experiments should be made to attract birds to infested localities by means of food and nesting boxes. The work done by Baron Hans von Berlespch at Seebach has been so successful that European foresters are putting up thousands of his nesting boxes in the government forests. Three thousand boxes which were used at the experiment station at Seebach were nearly all occupied by birds. How to attract and assemble birds and to increase their numbers, in the face of the advance of a destructive and overwhelming pest, will be a serious problem, but we should leave no stone unturned to find means to stay devastating insects. These suggestions are offered for the consideration of the Board and the State Superintendent for the Suppression of the Gypsy and Brown-tail Moths.

Suggestions for Legislation for the Protection of the Birds.

The progressive decrease in the numbers of fresh-water wild fowl, shore birds and game birds necessitates the enactment and enforcement of laws prohibiting the pursuit or killing of these birds at all times of the year except the fall months. This should be the only legalized shooting season. The season should be made as nearly uniform as possible, otherwise the law will be difficult to enforce. A people who continue to retain on their statute books a law which allows bird shooting from July 15 to May 30 must expect a continued decrease of these valuable birds.

Further provision should be made for reservations or bird refuges, and those species that are in greatest danger of extinction should be protected everywhere at all times. As Ornithologist of the State Board of Agriculture, the writer has persistently advocated the establishment of public reservations for the protection of birds and game. Such bird refuges as are maintained by the National Association of Audubon Societies and the Bureau of Biological Survey have demonstrated the feasibility of not only preventing the extermination of birds, but the possibility of greatly increasing their numbers. We may thus restore to the country such species as are not already too near extinction to admit of such restoration. Already Massachusetts has made some progress in this respect. Through the efforts of Mr. George H. Mackay, the town of Nantucket maintains a warden on the island of Muskeget during the summer of each year; thus one man has been instrumental in increasing the terns on the island by thousands. The State has taken the island of Penikese for a leper station, and Dr. Parker, the superintendent, protects the terns and other birds there with excellent results. The Commissioners on Fisheries and Game have control of a large tract of land on Martha's Vineyard for the protection of the pinnated grouse or heath hen and other birds.

As a preliminary step to a campaign for the purpose of securing other State reservations, correspondence with the State, county and city park commissioners was opened, to

ascertain on about how many acres of public land rules prohibiting shooting are enforced. Nearly all the park commissioners have responded to the inquiries made, and 52,234 acres of public land have been thus far reported on which all shooting is prohibited. This includes the lands controlled by the Metropolitan Park Commission, those of the Metropolitan Water Board, the mountain reservations of Greylock, Mt. Tom and Wachusett, all the land controlled by the Commissioners on Fisheries and Game, a new public preserve of about 5,000 acres, and the lands controlled by the 36 town and city park commissioners. There are in round numbers only about 8,400 acres of municipal parks, against 44,000 acres in charge of State, county or metropolitan commissioners. These statistics do not include the grounds of such public institutions as insane asylums, State farms or reform schools. There are between 50,000 and 75,000 acres (estimated) held in private estates, where the land is posted and controlled and no shooting is allowed. Many of the park commissioners enforce bird protection on their lands. In some cases city officers control the land and stop all shooting. The Metropolitan Park Commissioners have officers under their own control.

One of the most hopeful developments of the bird refuge idea is the formation of an association for the protection of birds and the propagation of birds, game and fish. This association has been organized, not for the purpose of securing a private game preserve for the use of its members alone, but for the purpose of establishing a State reservation on which all birds and game may be fully protected, and where experiments may be carried on in the methods of attracting birds and in the artificial propagation of game birds and wild fowl. Legislation is needed for the establishment of other preserves of this nature, both public and private.

Birds that eat the Elm-leaf Beetle.

The cedar wax-wing, cedar bird or cherry bird (*Ampelis cedrorum*) is now noted as the "bird that eats the elm-leaf beetle." Mrs. Mary Treat tells of a town in which the elms had been defoliated for several years by this beetle, but after

LEAST TERN AND YOUNG. (Photograph from life, by E. H. Forbush, at Katama Bay, Martha's Vineyard.)

the cedar birds came the trees were comparatively free from the beetle.

Mr. Outram Bangs gives an instance corroborative of Mrs. Treat's experience. He set out about twenty elms on his place at Wareham, Mass. About the year 1904, when the elms were fifteen to twenty feet in height, they were badly infested by the elm-leaf beetle; but cedar birds came regularly to the trees in constantly increasing numbers, searching every limb and twig. They even hung from the ends of the boughs, like titmice, looking the leaves over carefully and spying out the insects, until they cleared them all off, and the trees were not afterwards infested. During the summer of 1908 I attempted to learn by observation what birds were feeding on the elm-leaf beetles in Massachusetts; but in most cases the birds were so high up in the trees that it was not possible to determine accurately just what they were eating. It is evident, however, that the yellow-throated vireo is destructive to the elm-leaf beetle, and probably the warbling vireo is one of its most active enemies. A gentleman in Marshfield noticed four dead cedar birds under some elm trees soon after the trees had been sprayed to kill the elm-leaf beetles, and later when the grass was mowed he found several more. This raised the question in his mind whether the birds had not died from the effect of eating poisoned beetles. This question is worthy of some study.

The Possible Destruction of Birds by spraying with Arsenical Insecticides.

During the last decade of the nineteenth century many letters came to the Ornithologist of the State Board of Agriculture, expressing the opinion that the practice of spraying trees was fatal to birds. Correspondents stated that dead birds were found in sprayed orchards, and that birds diminished in numbers where spraying was carried on. A bulletin was published by the Maine State Board of Agriculture in 1898, in which four correspondents expressed the opinion that spraying was injurious to birds; but they gave no proof. During the spraying operations for the extermination of the gypsy moth in 1891 several flocks of fowls apparently were

fatally poisoned. Other instances which were brought to light where poultry was destroyed by a small quantity of Paris green indicated that birds were peculiarly susceptible to arsenical poisoning.

Since wholesale spraying for the gypsy and brown-tail moths began, in 1905, the finding of dead birds and the disappearance of living birds have been frequently reported. The arsenate of lead used in spraying for the gypsy moth is necessarily applied in much greater strength than the Paris green formerly used. Paris green can hardly be applied at a strength of 1 pound to 150 gallons of water without danger of destroying the leaves, and so defeating the purpose of spraying; but the arsenate of lead, properly made, can be sprayed with success at five to ten times this strength without injuring the foliage. In some cases this poison is used at such strength as to injure horses or cows grazing beneath the trees.

Arsenical insecticides do not kill insects by contact. The foliage is covered with the spray, so that leaf-eating insects may consume the poison with the leaves; they are thus poisoned internally. When it was seen that most of the gypsy caterpillars were uninjured by Paris green at the maximum strength at which it could be safely used on foliage, chemical tests were made of the internal organs and tissues of caterpillars that had fed upon it. A living and apparently healthy caterpillar was found to contain (in proportion to its size) twelve times the dose of arsenic which would be fatal to a normal man. Such caterpillars evidently eliminated the poison and lived. Some that had died apparently of arsenical poisoning had eliminated practically all poison from the system before succumbing to its effects.[1] Birds will not eat sickly or dying insects when they can procure healthy ones, and the habit of rejecting sickly larvæ had been supposed to render birds safe from arsenical poisoning from such sources. But if caterpillars in apparent health are able to carry much larger doses of arsenic in proportion to their size than would kill a man, the danger to birds, susceptible as they are to

[1] Forbush, E. H., and Fernald, C. H., "The gypsy moth," Massachusetts State Board of Agriculture, 1896, pp. 475, 476.

such poison, would seem to be great wherever arsenate of lead is used extensively and in great strength. Theoretically, this seems to be the greatest danger to which birds have been exposed by spraying. Nevertheless, certain species might consume arsenic by eating foliage or grass upon which the spray had fallen, or by drinking water contaminated by it.

Since the extensive spraying operations of the past year have begun, circumstantial evidence seeming to bear out the above assumption has been accumulating. The writer called attention to the matter for the first time in "Useful birds and their protection," in the following words: "Dead birds have been picked up in different localities soon after orchard or shade trees have been sprayed. Mr. Robert Ridgway noticed that birds decreased very much in numbers in a section of Illinois where practically all the farmers began spraying their orchards; but in a recent letter he expresses some doubt whether the spraying, or a bounty crusade against the sparrows, caused the diminution of the birds. The reduction of birds in such cases may perhaps be explained by the fact that the insects have been destroyed by spraying, this leaving the birds without food."[1]

Since the above was written, the Cambridge ornithologist, Mr. William Brewster, has informed me that in the past three summers, during which spraying has been continued in Cambridge, nearly all the orioles have disappeared. He also says that on his own estate the cuckoos and vireos have mostly vanished, as well as some of the warblers. He asserts that he also noticed a similar decrease of birds about his farm in Concord after the spraying of 1908. His attention was first called to the apparent destruction of birds by spraying when several years ago the street trees in Lancaster, Mass., were sprayed for the elm-leaf beetle. Many birds which were singing in the trees when the spraying began soon became silent and disappeared. Six were picked up dead two days afterward. When spraying became general in Cambridge, three years ago, Mr. Brewster asserts that redstarts had been increasing there for twenty years. Just

[1] Forbush, E. H., "Useful birds and their protection," Massachusetts State Board of Agriculture, 1907, pp. 360, 361.

before the spraying began, seven male redstarts were singing along the street between his house and Mount Auburn; soon after the spraying they all disappeared, and no redstarts have been breeding there since. Mr. Brewster's garden is enclosed by a cat-proof fence, and is a favorite resort for birds. But soon after the spraying the only bird songs to be heard there were those of the robin, yellow warbler and red-eyed vireo. Nearly all the birds disappeared in those years except a pair of red-eyed vireos, a pair of robins, one yellow warbler whose mate vanished, and one pair of cuckoos. The first year three dead birds were found; the second year, five. The species were yellow-throated vireos, a flicker, a redstart and a water thrush.

On the contrary, Mr. F. H. Kennard informs me that when spraying was going on near him he never missed a bird from its accustomed haunts. The question arises whether the insecticide used in his locality was the same in strength and character as that used at Cambridge.

The first conclusive evidence that spraying with arsenate of lead was fatal to bird life was obtained in 1907 by Mr. A. H. Kirkland. He had the digestive organs of a cuckoo examined, which had been picked up dead in the vicinity of sprayed trees. Both lead and arsenic were found in its stomach.

In the spring of 1908 extensive spraying operations were conducted against the gypsy moth, the brown-tail moth and the elm-leaf beetle. Reports came in that many birds were dying. A request was inserted in some of the daily papers to the effect that dead birds should be sent to the State Ornithologist for examination, but less than a dozen birds were received. The injuries of two black-billed cuckoos evidenced that they had been killed by flying against wires. Other birds showed marks of the teeth or claws of cats, with contusions and coagulations which left no doubt regarding the cause of death. There were only four whose death could not be accounted for by some other means than spraying. The organs of digestion of these four were examined by Dr. B. F. Davenport, but neither arsenic nor lead were found. The chemist then suggested that in future cases it would be

better to test all the tissues. Possibly the rapid digestion of birds and their habit of rejecting disagreeable food from the stomach might eliminate the poison from the organs of digestion in some cases before the death of the bird.

Some circumstantial evidence of the destruction of birds in small numbers was volunteered by people who had read the articles in the daily press. Mrs. E. M. Beals of Marblehead noted the disappearance of some vireos two days after the spraying, and reported that a good many dead birds had been found by the caretaker on an estate at Nahant. Mr. James H. Stark of Boston found two dead orioles following the spraying, and noted that a pair of nesting robins had disappeared. A worker on the gypsy moth force writes that he has found dead birds where spraying has been carried on, but has not found them elsewhere. He watched two sparrows' nests when the parents were taking canker worms from sprayed trees; in one case one of the parent birds died, and in the other the young perished. He noted that catbirds, cuckoos, redstarts, and orioles came to the trees after insects, and on looking about found two dead redstarts and one dead oriole. Miss Annie Chase of Beverly missed a pair of nesting indigo birds immediately after the spraying. It is noticeable that the dead birds found are of the species that feed on the gypsy moth, brown-tail moth or the elm-leaf beetle; and, while the evidence is circumstantial and not conclusive, it seems probable that some of these birds were poisoned. Where one bird was found, ten might have been overlooked or picked up by cats, dogs or other animals. While it is quite possible that considerable numbers of birds may be poisoned in this manner, the whole matter needs further careful investigation before any safe conclusion can be reached regarding the degree of mortality among birds from this cause.

Spraying cannot be given up because of any real or supposed danger to birds, but it should be undertaken only when the conditions are such that other means of restricting the moth injury cannot be utilized. Spraying for brown-tail caterpillars would be more effective if practiced in the fall when the small caterpillars first appear, and there would then

be far less injury to the birds than in the spring. Those who prefer not to spray can usually find other methods for protecting their trees against these insects. The cutting of undergrowth and trees and the trimming of trees is often found necessary in suppressing the gypsy moth; but it should not be done in spring and summer, when the birds are nesting, except in cases of extreme necessity.

Some Facts about the Natural Enemies of Birds.

A great deal has been said and written of late regarding the natural enemies of birds and game. Undoubtedly such enemies form a most potent check on the increase of birds' numbers, and where for any reason birds are decreasing in numbers, it may become necessary to destroy their natural enemies. Foxes, weasels, minks, skunks, squirrels and crows will need close watching at times, lest they become too numerous. The two common species of bird hawk, the cooper's hawk and the sharp-shinned hawk, are everywhere very destructive to birds; but the two natural enemies of our birds that seem to exceed all others in importance are the domestic cat and the so-called English sparrow.

Our native birds had enemies enough to keep them well in check before these destructive foreign species were introduced here. Individually, the cat and the sparrow are not so destructive as the bird hawk, but the destructiveness of a species increases as its numbers increase. Possibly every bird hawk eats on the average 2 small birds a day, or 730 birds a year, while only the adult cats in good hunting ground will average 50 birds a year each; but in the State at large there are probably at least 150 cats to every bird hawk, and provided that these 150 cats average only 10 birds apiece in the year, they would destroy 1,500 birds to 730 killed by the hawk. Proof of the destructiveness of cats was secured in my explorations of tern colonies along the Atlantic coast during the past summer. On Penikese Island there was one vagrant cat running wild; here and there young terns could be seen with their heads torn off. I was informed by the superintendent of the hospital on the island that this was the work

of the cat. At suitable places along the remoter beaches terns were attempting to breed, but wherever cat tracks were to be found in any numbers on the sands the birds had failed to establish themselves. The only localities where many young birds were found were far from dwellings, where there were but few, if any, cat tracks.

The cat is a very important factor in the destruction of the least tern. In 1907 a considerable colony of these birds was established not far from the Monomoy Point Lighthouse; but the birds met with no success in rearing their young, on account of the cats which then roamed the beach. In 1908 the colony evidently had been broken up, as no birds remained, and the beach was pitted with many cat tracks. Some of these cats are kept at the lighthouses and life-saving stations, but more are vagrants that have been turned loose by their former owners to pick up their living. They congregate about the life-saving stations, and find shelter beneath the buildings.

The cat is a handsome, strong, active and graceful animal. She is the type of feline ferocity and activity. She does not possesses the noble and self-sacrificing qualities of the dog, but is his superior in nocturnal activity, versatility and courage. Her chief claim upon mankind was stated years ago, in Robert B. Thomas' "Almanack," in substantially these words: "The cat is a good mouse-trap, and it is easy to set." Notwithstanding the number of cats supported by our population, rats and mice are nevertheless among the most destructive of all pests, and are constantly increasing in numbers; therefore in most homes the cat is regarded as a necessity, notwithstanding the fact that she carries diphtheria and other diseases that are peculiarly fatal to children. The increase and distribution of the cat is not regulated or restricted in any way by law in this country. This is a question which our legislators must take up sooner or later. In the mean time, the people can do much to mitigate the cat nuisance. No one living in the country should keep more than one adult cat. It should be well fed, and confined as much as possible from May to September, when young

birds are in the nest. All superfluous cats should be quietly chloroformed. No one should ever turn a cat loose to hunt for its subsistence.

Among the words of wisdom to be found in the old numbers of the "Old farmer's almanack" we find a means of breaking the house cat of the bird-killing habit. When the cat catches a bird, the dead bird should be tied securely under her neck and kept there as long as it will hold together. The disagreeable consequences of her act disgusts the cat, and she will not touch a bird thereafter. People who have tried this plan assert that it is effectual. It is well-known that some very intelligent and well-bred cats may be prevented from killing birds by punishment, but this will have no effect on others.

The English sparrow seems to be increasing in numbers in the country towns, and occupying more ground than formerly. It continues to drive out swallows, bluebirds and other species. The increase of poultry raising in the country is especially favorable to the sparrows, which annually devour thousands of bushels of grain intended for the fowls. Nevertheless, the sparrow, being a bird, has some of the good qualities of birds. Correspondents in the cities gratefully refer to the good these noisy foreigners are doing among the trees and shrubbery. Mr. S. A. Faunce of Boston writes that the sparrows have saved his roses from the "green worm"; also, they destroy the rose slug. Mrs. Ella M. Beals of Marblehead writes that the sparrows get a small worm that eats the new shoots on the cherry trees. Notwithstanding the fact that the diet of the sparrow is such that it is far less useful than any of the native birds, its great numbers make its useful habits very effectual.

But now comes a new danger, by reason of the presence of the sparrow about the poultry yard. Dr. Philip B. Hadley of the Rhode Island Experiment Station writes that in that locality over 80 per cent. of English sparrows have been found to carry the organism of a *Coccidium* which produces a disease called coccidiosis of fowls. This is the extremely fatal malady which has now made turkey raising almost impossible in New England, and which is more or less fatal to

LAUGHING GULL. (Photograph from life, by E. H. Forbush, on Muskeget Island, Mass.)

pheasants, as well as to other game birds. The English sparrow may therefore become a serious menace not only to poultry raising, but to the artificial propagation of native game birds as well. It is but just to say, however, that a few of our native birds carry the same disease.

The Useful Owl and the Pernicious Bird Hawk.

The value of the screech owl to the farmer, in contrast to the destructiveness of the sharp-shinned hawk, has been shown by an experience on the writer's place, beginning in 1906. In the winter and spring of that year the studies made of the food of a pair of screech owls that were staying in a small grove of white pines near the house at Wareham convinced the writer that they were desirable tenants. The pellets rejected by them, containing the undigested remains of their food, consisted almost wholly of the bones and fur of house mice, wood mice, field mice and mole shrews. The prolific little mice are potentially or actively destructive to trees, farm crops and birds' eggs or young. A nesting box was put out for the owls. This box, as described in "Useful birds and their protection," was of the following dimensions: 15 inches high, 11 inches deep and 7 inches wide; the size of the entrance was 3 by 4 inches. In March the owls began to occupy it, and in April they took in a few straws, sticks and other material for a nest, and the female laid and incubated five eggs. In due time the eggs hatched, and the parents were kept remarkably busy catching mice and insects for their young all through the spring and part of the summer. So far as we could determine, only a few birds were brought to the nest, — one robin, a red-winged blackbird and two or three jays. As a possible result of the killing of the mice and jays which are known to eat the eggs of the smaller birds, the little songsters of the farm seemed to have unusual success in rearing their young, and there were more small birds about the place in 1907 than in the preceding year. In the spring of 1908 the smaller birds had increased still more, but during our absence a pair of sharp-shinned hawks nested in the most secluded part of the grove. In July the young were found already fledged and flying about among the

tree tops. Wishing to see the result of their presence, we refrained from killing them. All summer the woods resounded with their cries; gradually the small birds disappeared from the neighborhood, until only a pair of chipping sparrows, two pairs of song sparrows and two pairs of chickadees remained. Finally, in early August, even the chickadees disappeared. The grove, which had formerly been a great robin roost in July and August, now became deserted and was given up to the hawks, who occupied it until the last of August, when they all departed, having decimated the bird population of their immediate hunting ground. After their disappearance in late August a few robins came back to the grove. The nests of these hawks are sometimes littered with the legs and feathers of small birds. They seem to prefer these little songsters to all other food. The effect produced by them served to emphasize the comparative harmlessness and the usefulness of the screech owl. It was a convincing object lesson.

The Means of protecting Fruit from the Attacks of Birds.

It has been stated in several publications that the Russian mulberry is of great service in attracting birds and protecting valuable fruit. This tree has proved a perfect success in Massachusetts, and probably it can be grown in all parts of the State. Mr. Outram Bangs has succeeded in raising it in Wareham, Mass., on the shore of Buzzard's Bay. He planted a considerable number, but succeeded in getting only two to grow and do well; the others winter-killed and died. He writes, on Nov. 15, 1908, that two trees are now in fine condition and one has been in bearing for years. Birds come to it in hundreds for the fruit. The fruit begins to ripen near the end of June or early in July, and continues all summer. The first tree came to bearing in about three years, and he now has another which is doing well. It has been set about three years, and he expects it to fruit next year. Any one intending to set out a few cherry trees should set at least one Russian mulberry also, to attract the birds away from the cherries and other garden fruit. An ideal com-

bination is secured by planting with the mulberry trees a fine hard variety of cherries. The birds prefer the fruit of the mulberry to the harder cherries. The experiment might not be so successful if the soft early varieties of cherries were planted, for these are very tempting to the birds.

According to Dr. Loring Puffer of Brockton, the Charles Downing mulberry possesses properties which may render it even superior to the Russian mulberry for the protection of other fruit. During my visit to Dr. Puffer's place, early in July, 1908, a Downing mulberry some fifteen years old and fully thirty feet high was fruiting heavily, and the birds were flocking to it. Near by was a large cherry tree of the variety called Ohio Beauty; this also was well laden with fruit. The cherries were large, black, ripe and delicious; when picked, they would keep for four days in excellent condition. There were no birds on the cherry tree, nor could any injured cherries be seen. The owner said that the native birds never troubled the cherries, but that sometimes the English sparrows took a few of them. The advantages in raising the Downing mulberry are that it is a quick grower and fruiter and a very early bearer; and the fruit, unlike that of most varieties of the mulberry, is not insipid, but excellent in quality and will furnish food for both bird and man.

There seems to be no doubt, in view of the experiments now made, that fruit may be practically protected from all birds in this way. Where there are no mulberry trees, and where robins are the chief culprits, a well-watered lawn and a fountain or spring at which the birds can drink may serve as some protection to the fruit. Probably most robins prefer a fat worm or grub to a cherry; but the cherries ripen usually at a time when the ground is becoming dry, and when the worms have retreated to the subsoil.

The summer of 1908 was very dry, and yet Representative J. S. Gates of Westborough informed me that the robins were not troubling his fruit as usual. Upon my inquiring whether there were any unusual conditions to account for this, he said there had been no change that he could see, except that he had been watering the lawn copiously, to keep the grass alive. He had noticed that the robins had been spending most of

their time on the lawn. Possibly the watering of the lawn had brought the worms to the surface, and so furnished the robins with food which they preferred to the cherries. The experiment of planting for the birds a row of soft, early cherries of the Governor Wood variety along one side of the cherry orchard was tried by Mr. G. T. Powell of New York. He writes that he has bird cherries by the bushel to spare, and that the birds are working on them, and leaving untouched his choice varieties, such as Montmorenci and Richmond. These he sells at an extra price, because they are entirely uninjured; while his neighbors, who have not provided for the birds, are forced to sell their imperfect cherries at a discount.

As a last resort, where one has few trees and no room for mulberries, the cherry trees may be covered with a fine fish net while the fruit is ripening.

EDWARD HOWE FORBUSH,
State Ornithologist.

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POTATO-GROWING SUGGESTIONS.

BY CHAS. D. WOODS, SC.D., DIRECTOR, MAINE AGRICULTURAL EXPERIMENT STATION.

While potato growing is somewhat a matter of soil and climate, it is even more dependent upon the ability, knowledge and energy of the man who is trying to grow them. This fact was very clearly demonstrated in Aroostook County, Maine, in the season of 1907. Aroostook County is perhaps the richest agricultural county in the United States, and the potato is the money crop. Upwards of 11,000,000 bushels of potatoes were shipped from the crop of 1906, besides all that went into starch. The shipments from the crop of 1907 were less than half that of the preceding year. And yet the good farmers had as large and in some instances larger crops than in 1906. The season of 1906 was favorable for a large crop, and everybody that planted potatoes succeeded in growing and harvesting a good crop. The season of 1907 was unfavorable, and only the good farmers had good crops. The men who thoroughly prepared the seed bed, on well-selected soil, planted only what they could properly care for, who used fertilizer liberally, cultivated all the season, and who sprayed early and often against insect and fungous enemies and harvested as soon as the crop was ready, not only had a large yield per acre, but the high prices that ruled for potatoes after the poorly grown early ones were marketed brought it about that with many Aroostook farmers the season of 1907 was the best for years. On the other hand, the farmer that planted illy adapted and slovenly prepared land, of larger area than he could well care for, who neglected to spray because the weather was not favorable for the spray to adhere, who had so many acres he could not get them harvested before the unusually early freezing of the ground (over 11,000 acres of potatoes were frozen in and remained unharvested in Aroostook County in 1907), found the year a disastrous one. In many instances the crop harvested was not sufficient to pay the fertilizer bills.

By practising the methods of the *good* farmers of Aroostook County, many men in other parts of Maine are successful with potatoes as a money crop. There is no reason why men in Massachusetts may not grow the potato at fully as good a margin of profit as the farmer in Maine.

The Potato demands Constant Care.

At the annual meeting of the Massachusetts State Board of Agriculture, in 1901, the writer in answer to a question said, in part: "If he plants a few potatoes, there is not one farmer in twenty but what something else would crowd in, and he would let the potatoes go. The one great reason we grow better potatoes in Aroostook County than elsewhere in Maine and Massachusetts is that it is the farmer's business to grow his potatoes. He does not keep cows, and he is not obliged to feed his cows or milk them; and there isn't anything he has to do but to take care of his field of potatoes, and that field will have from 20 to 50 acres in it. He keeps one man and a pair of horses working on each 20 acres from spring until fall, and this one man and pair of horses will care for the 20 acres, and he doesn't attempt to do anything else. That is one of the reasons we grow potatoes better, — because we are growing them for business. The potato growers are not thinking of the dairy cow or the breed of sheep; they are thinking about growing potatoes. When I used to live in Connecticut, up and down this Connecticut Valley there were men that ate, drank and slept tobacco; and so there are men that eat, drink and sleep potatoes in Aroostook County."

No One Best Method of Potato Culture.

The potato is so generally and so extensively grown, we are so familiar with its qualities and the various methods of culture, that most farmers are very positive as to the best method of growing this crop. During the past twenty-five years hundreds of experiments have been made at experiment stations and by practical growers, and the results from experiments in propagation and culture are so conflicting that the careful student will be very slow in drawing conclusions. While he will be convinced that there are ideal ways of treatment under certain conditions, he will be equally convinced that under different conditions very different practice will be necessary to insure the best crop. In potato growing, as with most farm operations, the soil and atmosphere are such determining factors that there is no best way. Each farmer who would grow potatoes to the best advantage must be sufficiently intelligent to understand the conditions of the soil on his own farm. The methods of preparation of soil, of planting, cultivating and fertilizing the crop, depend largely on the character and condition of the soil and the season.

A Few Points to be observed.

The successful growing of the potato crop demands careful and conscientious work from start to finish. There are many details which if neglected mean partial failure, and which must be cared for in order to insure the fullest success. It is not practicable in a short

article to hint at more than a very few factors which enter into successful potato growing.

Among the most important are: the selection and the preparation of the soil, including application of fertilizer; the seed and the care of the crop during the growing season.

The Soil.

A soil to grow potatoes well must be in an excellent state of tilth, sufficiently mellow to make a good seed bed and place for the tubers to develop. Abundant plant food must be supplied, and the land must be so situated that it will not suffer if rain should be excessive, and must, on the other hand, be well adapted to stand drought. If not naturally well drained, it must be underdrained. If it is not of good water-holding capacity, this must be secured by increasing the humus by green manuring or the use of liberal quantities of stable manure.

Water a Necessity.

There is no farm crop that is more easily, speedily and greatly affected by the supply of moisture than is the potato. It has been found by experiment that it takes about 425 tons of water to grow a ton of dry matter of potatoes. A crop of 200 bushels per acre would therefore require approximately 650 tons of water, — equivalent to a rainfall of nearly 6 inches. Because of its need for large water supply, and its remarkable susceptibility to climatic conditions, it follows that the average potato yield is affected more by water supply than by lack of plant food. The selection of soil and methods of culture must be with this fact in view, if success is to be had. The liberal application of fertilizers or the presence of large amounts of readily available plant food will prove of but little value if the moisture supply is deficient. It is also true that too much water will check the growth as quickly and effectually as too little.

Too much attention to the fitting of the soil for the crop can hardly be given, for no amount of after-tillage can overcome neglect in preparation. Deep and thorough plowing and harrowing, so as to make a perfect seed bed, not only establishes an earth mulch, so as to prevent the loss of moisture of the spring rains, but it so fines the soil that the plant food contained in it becomes accessible to the growing plant. The conservation of moisture by frequent tillage is not understood or practised as it should be. The old notion that potatoes should be hilled, and that tillage should cease as soon as the potato is in bloom, is wrong for most situations. Hilling is frequently practised so as to keep the tubers from becoming exposed to the sun; this is not necessary if the soil was properly prepared. On hard, compact soil the potato will, because of less resistance of the soil, push out of the ground. This will not happen in deeply worked land.

Preparation of Soil.

The proper preparation of a soil for the potato crop is a matter of years, and not a single season. A soil in order to do the best must be in an excellent state of tilth and a high state of fertility. Such conditions can be obtained only by careful forethought and planning. In many instances the soil is not plowed deeply enough. It is very common for people to speak of plowing 7, 8, or even 9 inches; but most men would be surprised if they were to apply a rule to see how much short of this depth the plow goes below the actual level of the field. Many men that think they are plowing 7 or 8 inches deep are only plowing 5 inches. If this shallow plowing has been practised, it is bad management to suddenly deepen the plowing, as this brings too much of the sub-soil to the surface in a single plowing.

Good potato land may be handled in a three or four year rotation, — potatoes, grain, grass one or two years, and then potatoes again, in some such way as the following: land which is used for potatoes should immediately after harvesting of the crop be treated to a liberal application of farm manure, if it can be obtained, and plowed with lap furrow. The plow can well run an inch deeper than it did the preceding year, when the land was prepared for potatoes. In the spring the soil will have crumbled by the frosts, and should then be thoroughly and deeply worked by frequent harrowings with some such tool as a disc or spading harrow. It should then be smoothed with an Acme harrow or some similar tool, and seeded to grain. If it is designed to grow only a single crop of grass, it is best at the time of seeding to sow clover with the grain. If, however, it is designed to remove two crops of grass, it can be seeded with a mixture of clover and timothy. The grain crop will be harvested the first year; the second season, the crop will be chiefly timothy; the third, it will be timothy and clover; and at the end of the two or three years, whichever plan is followed, there will be in the field in the fall a good stand of second-growth clover. This should not be cut or fed, but should be plowed under, and this is all the more important if the piece has not been treated with farm manure. This fall plowing should be with lap furrow, and the following spring it should be thoroughly worked with the disc and smoothing harrows, in order to get ready for planting.

It may in many situations be desirable to follow the grass crop with corn, and then follow with potatoes. The same thorough preparation will be of advantage to the corn crop. The land for the corn should be liberally fertilized. Farm manure may be again used to advantage at this point in the rotation. The corn crop must be overfed in every way, so that the land will be in a higher state of fertility at the end than at the beginning of the season. If corn enters into the rotation, fall plowing should be again practised, and the following

spring the land should be thoroughly worked. The best possible seed bed should be prepared, so that the soil will be light and thoroughly pulverized to a depth of 5 or even 6 inches. In a soil thus prepared the planter will run easily.

The Potato needs Abundant Plant Food.

It is always profitable to fertilize a money crop liberally, and, while a crop of 300 bushels of potatoes will remove from the soil about 55 pounds of nitrogen, 25 pounds of phosphoric acid and 85 pounds of potash, it is probably wise to furnish the phosphoric acid in considerable excess and the potash in fair excess. The plowed-under clover and the fertility which has been accumulated can be depended upon for part of the nitrogen. By many experiments it has been found that the potato plant thrives best in a soil abundantly supplied with all fertilizing elements. In the early stages of growth nitrogen is particularly demanded, and hence a considerable part of the nitrogen should be in a readily available water-soluble form. This is necessary that it may be utilized by the plants early in the season. Later when the tubers are forming, there is special demand for phosphoric acid and potash.

Selection of the Fertilizer.

In the selection of a fertilizer, a farmer cannot be guided by the name alone. There are all kinds of "potato" fertilizers upon the market, — those carrying from 1 to 5 per cent nitrogen, from 5 to 10 per cent phosphoric acid and from 2 to 12 per cent potash. In selecting the fertilizer, something more than percentage composition must be taken into account.

At the present time a 4–6–10 fertilizer, carrying 4 per cent of ammonia, which is equivalent to 3.3 per cent nitrogen, 6 per cent available phosphoric acid and 10 per cent potash is a popular potato fertilizer in Maine. Used at the rate of 1,500 pounds to the acre, such a fertilizer would supply about 50 pounds of nitrogen, 90 pounds available phosphoric acid and 150 pounds of potash. Obviously such a fertilizer when compared with the needs of the crop is out of balance. As the results of field experiments with potatoes, it is probable that the excess of phosphoric acid is valuable to the crop. There is no evidence, however, to show that the potato crop is benefited by such a great excess of potash. It would seem that if 1,500 pounds of a high-grade fertilizer is to be used, one carrying 6 or 7 per cent of potash in place of the 10 would be better balanced.

The Form of Fertilizing Ingredients.

In 1907 a high-grade potato fertilizer was used in large quantities, in Maine, on potatoes, which did not carry any nitrate nitrogen. There was quite a general complaint as regards failure with this

particular fertilizer, and much dissatisfaction, leading even to the threatening of law suits, because of the short crops supposedly due to this fertilizer. Careful examination of this fertilizer showed that its constituents were all high grade, and that, while it fell somewhat below its guaranteed analysis, it still was high-grade goods. The dissatisfaction and poor results from the use of this fertilizer were probably due to the absence of nitrate nitrogen. The grower in a climate where the growing season is so short must see to it that the fertilizer used, and particularly on the money crop, carries a fair proportion of its nitrogen in the form of nitrate nitrogen. Fully a third of the nitrogen in a fertilizer carrying 3.3 per cent nitrogen could with safety be in the form of nitrate. It would not do to have much more than that in the form of nitrate, because of the danger of loss from leaching out by heavy rains. From field experiments conducted by the Maine Experiment Station, it is not advisable to have much, particularly of dry mixed, *bone* tankage in the fertilizer, as it seems to stimulate the growth of the tops too late in the season. Where one can know relative to the source of the nitrogen, it is probably desirable to have about a third as nitrate nitrogen, and the rest in the form of dried blood or high-grade tankage. Sulphate of ammonia is a good source of nitrogen, becoming available more quickly than tankage, but is not as immediately available as nitrate of soda. While it is water soluble, there is not nearly the danger of loss by leaching as there is with the nitrate. It matters little whether the phosphoric acid is from bone or from rock phosphate; but it is necessary that in any case it be acid-treated, so as to be in the available form. There seems to be no difficulty as to the form of phosphoric acid and its availability in any of the high-grade fertilizers offered in New England. With certain crops, sulphate of potash gives better results than does muriate, and there is more or less of a general opinion that sulphate of potash produces better quality of potatoes. There is, however, very little evidence to support this conclusion. Practically all the potash in New England sold fertilizers is in the form of muriate or sulphate, and it seems to make little difference which form of these two is used.

Amount of Plant Food per Acre.

Even on soil of high fertility, it is found profitable to fertilize liberally. For a large crop, the fertilizer should carry not less than 50 or 60 pounds of nitrogen, one-third of which should be in the form of nitrate, not less than 60 pounds of available phosphoric acid and not less than 100 pounds of potash. About two-thirds of this can best be applied in the drill at time of planting and the rest at first or second cultivation.

To most Massachusetts farmers this amount of plant food for the potato will appear excessive, but it is found profitable in practice.

Planting and Cultivation.

On the whole, medium-sized potatoes cut into four pieces seem to be the best adapted for seed. These are planted at a fair depth with either of the planters which are in common use. Not more than 1,000 or 1,200 pounds of a fertilizer should be applied in the drill at the time of planting. The drills should be from 34 to 36 inches apart, and the pieces planted from 12 to 14 or 16 inches apart in the drill, according to whether it is a small or vigorous growing variety. All through the growing season the field should be kept free from weeds. The exaggerated ridge culture which is so common in Aroostook County could be better replaced in Massachusetts by a less pronounced ridge, or as level culture as is practicable. Suitable potato land is naturally or artificially so well drained that it does not suffer from excessive moisture, and with the high-ridge culture there is danger even in a moderately dry season of the crop suffering from lack of water. The frequent running of the cultivator not merely keeps down the weeds, but it lets the air into the soil and prevents excessive loss of moisture from evaporation, and in every way seems to be beneficial to the crop. This should be kept up until the vines pretty well cover the ground. If weeds are appearing in the drill, these should be removed by hand.

Spraying.

Of everything which has to do with the care of the potato in its growing stage, there is nothing that is so important as the spraying, both to prevent blight and to protect from injury against insects. The following suggestions for fighting the enemies of the potato are condensed from a circular of the Maine Agricultural Experiment Station, and can be had on application to the Station at Orono, Maine.

Insect Enemies.

The small black flea beetle eats minute holes in the leaves, sometimes making them look like the cover of a pepper box. Poisons have little effect upon it, or upon the mature Colorado beetles. Bordeaux mixture is very distasteful to both of these insects, and if thoroughly applied is a most effective agent in holding them in check.

The larvæ or slugs of the Colorado beetle (potato bug) can readily be killed by poisons. These poisons are best applied with water in the form of a fine spray just *before* the eggs hatch. The smaller the slug the easier it is killed.

If applied as a fine spray before the plants are badly infested, ½ pound of Paris Green, 2 pounds of Swift's arsenate of lead or 2 pounds of Bowker's Disparene per acre at each application will prove effective. Arsenate of soda (see Formula 11, p. 368) is a cheaper poison, but it must always be applied with Bordeaux mixture, never alone. In

case the slugs are abundant, a second application may be necessary inside of two or three days. If the poisons are applied just before the eggs hatch, three applications at intervals of seven to ten days will usually be sufficient during the season. The poisons can be applied alone (Formula 3 or 4) or with Bordeaux mixture (Formulas 7, 8 and 11).

Caution: *Paris green poisons should never be used alone on potatoes except on the addition of from 3 to 5 pounds of unslaked lime to 50 gallons of spray, depending upon the amount of poison used.*

Potato Scab.

Potato scab, which is too well known to need description, can be held in check by planting previously treated seed in clean land. As it is very difficult to get this fungus out of the soil, great care should be taken not to get it in. Soak the uncut seed potatoes one and one-half hours in Formula 1, or two hours in Formula 2, and then spread out to dry. After drying, the potatoes may be cut and planted in the usual way, care being taken not to allow them to touch any box, bag or bin where scabby potatoes have been kept. Treatment with formalin is safer than corrosive sublimate, and on this account is preferred. All tubers treated with corrosive sublimate should be planted, to avoid danger from the poison on them. For the larger grower or seed dealer, disinfection by means of the formaldehyde gas method, as described under Formula 10, is the most satisfactory procedure.

Early Blight.

This disease (sometimes improperly called rust) seldom produces so much damage in any one year as does late blight. Nevertheless, it is widespread, and very destructive in that it attacks and weakens the plant at a critical period, thus checking the development of the tubers. It is confined to the foliage, and is not known to cause rot. Early blight first appears as small brown spots scattered over the older leaves. These slowly enlarge and frequently become somewhat angular in shape, from the fact that they stop on reaching a leaf vein. To control this disease, early, frequent and most thorough sprayings with Bordeaux mixture (Formula 6) are necessary.

Late Blight or Rot.

This disease is caused by a fungus which attacks both the foliage and the tubers. In this latitude it most frequently becomes epidemic during the damp, muggy weather of August and September; it does little damage during hot, dry weather. Late blight may be well distributed over a field before it is noticed, except by a trained observer. As a rule, it first appears on the lower and more shaded leaves, which are hidden from view. Contrasted with early blight, it is more of a leaf blotch than a spot disease. The diseased portions are brownish

or blackish areas, the leaf green fading out as it approaches the spot, which rapidly enlarges and becomes moist and ill smelling. The margins of the under sides of such spots show a delicate frost-like mildew if examined on a moist, cloudy day or in the early morning. This is the fruiting portion of the fungus, and on each spot are produced thousands of little fruiting bodies, each capable of causing another spot.

The washing of late blight spores down into the soil is directly or indirectly the cause of much of the loss from rot of the tubers both in the field and in storage. The most common dry rot of the tuber in Maine is caused by this fungus. Thorough spraying with Bordeaux mixture (Formula 6), beginning before the blight appears, and keeping the foliage well coated till killed by frost or the crop is harvested, will reduce the losses from this disease to a minimum. No tubers showing dry rot should be planted.

When to Spray and how to Spray.

Begin when the tops are 6 or 8 inches high, and spray every ten days (every week, if the weather is very cloudy and rainy) until the last of August or the first of September, or later if necessary. In any event, spraying must be begun some days before the average observer will detect blight on the leaves, and the foliage should be kept well coated with Bordeaux mixture up to the time the crop is harvested or the tops are killed by frost. Do not stop for rainy weather; this is just the time when late blight spores are formed in profusion, and when infection most easily takes place. It is possible for a spraying just before a rain, even though it is largely washed off, to do more actual good than any other during the season. Moreover, properly prepared Bordeaux mixture, if thoroughly applied, will withstand severe washing if it once thoroughly dries on the leaves. The best results are obtained when the mixture is forcibly applied in the form of a fine mist, *not* in coarse drops sprinkled over the foliage.

As is described elsewhere, the nozzles should be so arranged and of sufficient number and adjustments as to cover the entire row at each application. Do not limit the amount applied per acre to an arbitrary number of gallons, but use enough at each application to thoroughly coat the foliage, whether it requires 50, 100 or 150 gallons per acre. Use a pump powerful enough to develop a pressure of at least 60 pounds with all the nozzles open.

Formulas for Scab.

FORMULA 1.

Corrosive sublimate, ...	2 ounces.
Water, ...	15 gallons.

The corrosive sublimate dissolves readily in water. Immerse seed tubers for one and one-half hours in this solution.

FORMULA 2.

Formalin (40 per cent solution formaldehyde),	8 fluid ounces.
Water,	15 gallons.

Immerse seed tubers two hours in this solution.

FORMULA 10.

For disinfection with formaldehyde gas: —

Potassium permanganate,	23 ounces.
Formalin (40 per cent solution formaldehyde),	3 pints.

The above is sufficient for each 1,000 cubic feet of space. Place the seed tubers in bushel crates or shallow slat-work bins in a tight room; spread the potassium permanganate evenly over the bottom of a large pail or pan in an open spot in the centre of the room; pour the formalin over this, and give the dish one rapid tilt, to ensure thorough mixing; leave the room at once, and tightly close from without. The bins or crates should be so arranged that the gas can circulate on all sides of them and mix with the air of the room before it comes in contact with the potatoes. *To avoid injury from the strong gas as it is liberated, no potatoes should be placed directly above the generator.*

Formulas for Beetles and Slugs.

FORMULA 3.

Paris green,	½ pound.
Lime (unslaked),	3 pounds.
Water,	50 gallons.[1]

The standard remedy for the destruction of insects which eat the foliage or fruit. The lime is added to prevent the Paris green from burning the foliage. Slack the lime in a little water, and make a thin paste and strain; wet up the Paris green with a little water into a thin paste; mix the lime and Paris green and add the remainder of the water.

FORMULA 4.

Lead arsenate or disparene,	2 pounds.
Water,	50 gallons.[1]

Arsenate of lead acts slower as a poison than Paris green, and for that reason is not so effective for killing insects on rapidly growing plants like potatoes. It can be kept suspended in the water better than Paris green. It does not burn the leaves, and sticks to the foliage better than Paris green. Make a smooth, thin paste with the poison and a little water, and add the remainder of the water and stir thoroughly.

[1] An ordinary oil barrel holds about 50 gallons.

Formulas for Blights, — Bordeaux Mixture.

FORMULA 6.

Copper sulphate,	5 pounds.
Fresh lime (unslaked),	5 pounds.
Water,	50 gallons.[1]

FORMULA 6A.

Copper sulphate,	5 pounds.
Hydrated lime (prepared or ground lime),	6–7 pounds.
Water,	50 gallons.[1]

Bordeaux mixture according to Formula 6 is prepared as follows: — the copper sulphate is dissolved and the lime slaked in separate vessels. A wooden or earthen vessel must be used for the copper sulphate, as it corrodes iron. Each solution should then be diluted with half the water, and then the *cold, dilute sulphate and milk of lime solution quickly united and thoroughly mixed.* Never pour concentrated solutions together. If impracticable to pour the two dilute solutions into the sprayer or mixing tank simultaneously, the dilute copper sulphate solution should be first placed in the tank and the dilute milk of lime solution quickly added with constant stirring.

Best results are obtained if care is taken to add the water slowly to the lime while slaking, but it should not be allowed to become dry. The milk of lime must be strained, and this is best done while still hot. A brass wire strainer of about 30 meshes to the inch (No. 50), or a piece of cheese cloth backed by common window screen, may be used. The best type of strainer can be made by nailing together four 1-inch boards about 7 or 8 inches wide and 12 or 15 inches long, making a box open at both ends. One end of the box is then cut off at a considerable angle, leaving one side shorter than the other. No. 50 brass wire strainer is tacked on to this end. Two cleats are nailed to the other end of the box, long enough to more than reach across the top of the barrel. When placed on top of a barrel with the wire bottom down, all the solid particles from the solution are washed to the lower side of the screen, thus avoiding clogging the whole surface.

The most convenient method of preparing Bordeaux mixture is to make stock solutions. For this purpose suspend 100 pounds of copper sulphate in a bag near the top of a 50-gallon barrel and fill with water. This should dissolve over night. In another 50-gallon barrel slake 100 pounds of stone lime, dilute and strain and make up to 50 gallons. A gallon of each solution *well stirred* will be equivalent to 2 pounds of copper sulphate or lime, as the case may be. For a 50-gallon tank of mixture the stock solution should be thoroughly stirred, and then 2½ gallons of each dipped out, diluted and mixed as described above. For a 100-gallon tank 5 gallons of each stock solution is used, and each diluted to 50 gallons before mixing.

[1] An ordinary oil barrel holds about 50 gallons.

Bordeaux mixture according to Formula 6A is prepared in exactly the same manner as in Formula 6, except that slaking the lime and straining the resulting solution is dispensed with. The required amount of lime is weighed out, wet up with water, diluted, and then thoroughly stirred. Stock solutions of hydrated lime can also be used.

Formulas for Bugs and Blights.

Make a smooth paste of the poisons and a little water; add to the Bordeaux mixture and stir thoroughly; apply at once.

FORMULA 7.

Paris green, ...	½ pound.
Bordeaux mixture, ...	50 gallons.[1]

FORMULA 8.

Lead arsenate or disparene, ...	1 pound.
Bordeaux mixture, ...	50 gallons.[1]

FORMULA 11.

Arsenate of soda stock solution, ...	1 quart.
Bordeaux mixture, ...	50 gallons.[1]

Arsenate of soda stock solution is prepared as follows: place 2 pounds of white arsenic and 8 pounds of sal soda in 2 gallons of water. Store in well-stoppered bottles or jugs with a poison label on them. This is a much cheaper poison than Paris green to use with Bordeaux mixture, and it remains in suspension better, but it is not safe to use it alone with lime. White arsenic costs less per pound than Paris green, and will go twice as far, in that 2 gallons of arsenate of soda stock solution will do as much execution as 4 pounds of Paris green.

Condensed Directions.

A. For Scab. — Immerse the tubers one and one-half hours in a solution of corrosive sublimate (Formula 1), or two hours in formalin (Formula 2), or disinfect with formaldehyde gas (Formula 10).

B. For Insects. — Spray with a poison alone (Formulas 3 or 4). If flea beetles are numerous, or there is danger from blight, use combined Formulas 7, 8 or 11.

C. For Blights. — Begin to spray when the tops are 6 or 8 inches high, and spray thoroughly every ten days, — every week, if necessary. If insects are plentiful, use combined Formulas 7, 8 or 11. After danger of insects is passed, use Formula 6.

Usually six and sometimes four sprayings are sufficient to protect against late blight; but the leaves should show a coating of Bordeaux from the time spraying begins till the crop is harvested or the tops

[1] An ordinary oil barrel holds about 50 gallons.

are killed by frost. One thorough spraying in rainy weather before late blight has gained a foothold may be the most effective application of the season. If early blight is prevalent, five or six *very thorough* sprayings, beginning early in the season, are necessary to insure sufficient protection.

Summary.

To successfully grow potatoes: —

Select highly fertile land, so situated that it will suffer as little as possible from either excessive rain or from droughts.

Thoroughly prepare the soil, and fertilize liberally.

Spray for insects and blight, early and often.

Keep the crop free from weeds and the surface of the soil loose during the whole season.

Do not let anything prevent the potato field from receiving constant care. Vastly more failures in potato growing in Massachusetts can be traced to neglect of crop than to lack of knowledge.

DRAINAGE.

BY PROF. WM. P. BROOKS, DIRECTOR OF MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

There is a great field for the profitable investment of capital in the drainage of land either at present entirely unproductive, or producing far lower returns than it is capable of because of faulty conditions as affecting the supply of water. It is not as generally recognized as it should be that the returns in agriculture are controlled in a large degree by the physical conditions in the soil, as affecting especially the water supply and its temperature. Everybody knows that a field where water stands during any part of the growing season needs drainage, but it is not so generally understood that the productive capacity of many other fields would be greatly increased by the establishment of better drainage conditions. It is essential for the healthy growth of practically all the cultivated crops of the field, garden and orchard, as well as for our most valuable grasses and clovers, that the soil area occupied by the roots should contain air as well as water.

On going downwards in any field we reach a point below which water occupies all the spaces between the soil particles. In this part of the soil the water is relatively stagnant, and it is impossible for the roots of most of our valuable plants to maintain themselves in that portion of the soil thus filled with water. It is customary to designate the water which thus stands between the soil particles as hydrostatic water; and the surface of this body of hydrostatic water, the level of which would be determined by sinking holes sufficiently deep to reach it in various parts of the field, is usually designated the water table.

Above the water table the existing condition is quite different. The soil contains some air between its particles, while the particles themselves are surrounded by films of water which are held by capillary attraction and surface tension. It is customary to designate the water thus held on and between the particles of soil as capillary water.

The capillary water of the soil may be derived in a considerable measure from the rains and melting snows, a part of which is held as the water sinks through the soil by the forces which have been referred to, but, especially in seasons of prolonged absence of rain, this

water is drawn also by capillary attraction from the body of hydrostatic water below. Just as oil is drawn through the wick to feed the flame, so water is drawn from the great reservoir of hydrostatic water below (the soil above the water table serving as the wick) to supply the loss near the surface, due to exposure to sun and wind and to the demands of vegetation.

The amount of capillary water in that portion of the soil which lies above the water table will vary in all cases with the distance above the water table. That part of the soil which lies close to the water table contains relatively large amounts of water, while the proportion, supposing the character of the soil to remain uniform, gradually decreases as the distance above the water table increases, or as the surface is approached.

The proportion of capillary water in the soil which is desirable varies to a considerable extent in the case of different plants, but, as a general rule, it may be stated that in the immediate vicinity of the water table, in soils of fine texture, at least, the proportion of water will be too great for the best activity of the roots of most plants. In most soils it is only when a point lying at a distance of from one to two feet above the water table is reached that we find the most favorable proportions of water and air for the root development and activity of most plants. This fact, as will be pointed out later, has an important bearing upon the proper depth of drains.

Special Reasons for the Importance of Drainage in Massachusetts.

The owner of land or the capitalist looking for investment must naturally carefully consider the question of probable returns on money invested in drainage. It is the belief of the writer that money thus used will prove not only one of the safest, but also one of the most profitable, investments in many cases. Space will not allow a full discussion of the subject, but the following are among the more important of the points to be taken into consideration.

1. The soils which are in need of drainage are in general of much greater fertility than the average soils of the State. The low lands especially come under this class, for from time immemorial they have received the wash of the higher lands, and they have, moreover, in many cases been enriched by the gradual accumulation of organic matter. It follows, therefore, that these low lands, if relieved of surplus water, become not only good farm lands, but that their value for farm and garden purposes will be much greater than that of much of our upland. The necessity for drainage, however, is not confined to the low lands. There are many elevated tracts of land, and especially many hillsides, requiring drainage for the establishment of more profitable agriculture. In a great majority of instances the soils in such localities are of strong retentive character and if relieved of surplus water are increased greatly in value for agriculture.

2. Massachusetts possesses a very large area of swamp and marsh land, — in many cases extremely well located as regards facilities for market and for transportation to market. To drain our most extensive swamps and marshes in a satisfactory way will require a careful study of the situation and the adoption of comprehensive and carefully considered plans. It will be necessary, therefore, for the numerous small holders to work together co-operatively, or that the small holdings be united, in order that the new improvements may be economically carried out.

3. Besides these swamp areas, there exist almost all over the State places in many of the fields now under cultivation where the product is inferior both as regards quality and quantity, on account of imperfect drainage. In these relatively unproductive portions of fields already under cultivation, the work of drainage should in many cases begin.

4. The markets of Massachusetts are probably unsurpassed in any part of the world; certainly they are unsurpassed in any part of this country. There can be no doubt, therefore, that the product of the wide areas at present unproductive will find a profitable market.

The Beneficial Effects of Drainage.

The principal benefits following the drainage of land suffering from excess of water may be stated as follows: —

1. It deepens the soil. As has been stated, only that portion of the soil is accessible to the roots of most of our valuable plants which lies above the water table. If the average depth of the water table below the surface of the ground during the growing season is two feet, the total mass of soil through which the roots extend and on which they can feed is only one-half as great as it would be if the average level of the water table is four feet below the surface. Reducing the level of the water table in one sense, therefore, enlarges the farm. True, the soil at the lower levels may not be equally rich in the elements of plant food with that nearer the surface, but its contribution in that direction is nevertheless important. Some of the readers of this paper may ask the question whether the roots of our ordinary plants will penetrate to the lower soil levels rendered available by drainage. Upon this point the writer has not the slightest doubt. The roots of most of our common crops penetrate far more deeply than is generally supposed, and there are probably few if any among the common cultivated crops that will not send roots to a depth of at least four feet, provided the soil conditions are favorable.

2. Drainage promotes more perfect aeration. The air cannot penetrate a water-logged soil. The action of the oxygen of the air upon the various soil constituents is favorable in several important directions.

(*a*) It promotes oxidation, and gradually renders soluble and available numerous soil compounds which but for this action must remain inaccessible to the growing crop.

(*b*) Only in well aerated soil do the organisms whose activity is essential to the formation of nitrates flourish.

(*c*) Well aerated soils are favorable to the multiplication and activity of numerous other beneficial micro-organisms whose activity increases the productive capacity.

(*d*) The living root itself can maintain a condition of healthy activity only where the soil contains air as well as water.

3. The average temperature of the soil through the growing season is raised by drainage, and the growing season itself is practically lengthened, because rapid growth will begin earlier in the spring and continue later in the autumn.

4. Better tillage becomes possible; a wet soil cannot be brought into satisfactory tilth.

5. The probability of injury to growing crops in periods of drought is reduced. This statement may at first thought seem to be a paradox. The reader may be inclined to say that it seems unreasonable that damage from drought should be reduced by relieving the soil from surplus water. The fact, however, is unquestioned. The effect appears to be due principally to the following causes: —

(*a*) The water table being reduced, roots penetrate to levels further removed from the surface and therefore retaining water more effectively in periods of intense heat and drought.

(*b*) The physical condition of the soil above the water table is modified and improved. Its capillary qualities are increased. It conducts water from the great reservoir below more effectively.

(*c*) The feeding rootlets range more widely and deeply and are in a position, therefore, to draw moisture from a much larger soil area than on undrained fields.

6. Seeds germinate more certainly and perfectly.

7. The probability of surface wash is reduced, for the water of heavy rains and melting snows is free to settle into the soil instead of running off over the surface.

8. The sanitary conditions are improved.

Indications of Desirability of Drainage.

It will be apparent to all that in all cases where, under ordinary conditions, water stands on the surface of the ground for any length of time, except of course when it may be frozen in winter, drainage is essential. It will, however, prove highly beneficial in many localities where it seldom or never stands at the surface. The character of the natural vegetation affords clear indications. In all places where sedges, rushes and water grasses flourish it is certain that drainage will be beneficial. The writer advises determining the average level of the water table in all cases where there is doubt. This is easily done by sinking holes in various parts of the field in question. The height of the water in these holes indicates the level of the water table, and if this, during the growing season, is found to be less than three and

one-half to four feet from the surface during considerable periods of time, it is certain that the agricultural value of the field would be increased by thorough drainage.

Kinds of Drains.

Doubtless the first form of drain constructed by man was the open ditch. Such ditches are in many cases still in use. The open ditch as a channel for rapidly carrying off surface water is frequently desirable, but as a means of thorough drainage is highly unsatisfactory. The principal reasons are as follows: —

1. The cost of construction is heavy. The sides must be sloped in order that the ditch be reasonably permanent. The amount of earth which must be removed is much greater than for underdrains of the same depth.

2. The cost of maintaining an open ditch is high. In many cases the banks cave or wash and vegetation gradually obstructs the channel. The open ditch to be satisfactory requires frequent attention.

3. The open ditch requires too much land and is an obstruction to farm operations.

Underdrains.

All of the different kinds of underdrains are free from many of the faults which have been named in discussing the open ditch, and all of them, therefore, have important advantages in operations designed for the thorough drainage of land over open ditches. They are by no means all of equal merit. The principal types of underdrains worthy of consideration are the following: pole, box, stone and tile.

Pole and Box Drains. — Both of these types of drains if properly put in will do effective work for a time, but both are open to one serious objection, — the material used in their construction is perishable. The principal item of cost in all of the different types of underdrains is labor. It is therefore, in general, bad policy to employ in the construction of drains any material which is perishable simply because it costs less than something which is permanent. The pole or box drain will last but a relatively short time on account of the decay of the wood. The methods of constructing these drains, therefore, will not be given.

Stone Drains. — The material used in the construction of these drains is practically imperishable. In this respect, therefore, these drains equal tile drains. In other important particulars, however, they are inferior. The following are the principal points: —

1. As stones are more bulky in proportion to efficiency than tiles, the ditches to receive them must be larger.

2. If a regular conduit is built by the use of stones more labor is required than in laying tiles..

3. It is not possible with such stones as are usually available to build a conduit which will have sufficiently close joints to effectively

exclude sand and silt. Stone drains are, therefore, more likely to become clogged in most soils than tile drains.

4. Because of the nature of the material used the stone drain inevitably presents rougher surfaces to the passage of water, and any obstructions which enter the drain are therefore more likely to remain in it.

Because of these reasons it is not believed that it will usually be wise to put in stone drains. The only saving is the outlay required for the purchase of the tiles, and this saving will in most cases be much more than offset by the extra costs of putting in which have been referred to. Stone drains will prove most durable in soils of heavy and compact character, because in these soils they will be less likely to fill with silt and sand. In such soils, where stones of suitable character are available for drain construction, it may possibly sometimes pay to put in stone drains, although even this is open to question.

Tile Drains. — Drainage by means of tile made especially for the purpose is practically the only system of thorough underdrainage that can in most cases be advised. Tile drains are better than drains of any other kind for many reasons, most prominent among which are the following: —

1. On account of their regular form they offer a smoother and more uniform conduit for water, and are, therefore, less liable to obstruction than drains made of any other material.

2. Closer joints can be made than in most other kinds of underdrains, and the probability of entrance of silt and fine sand is therefore less.

3. The material is practically imperishable if placed below the reach of frost.

Kinds of Tiles.

Numerous forms of drain tiles are offered in our market. It is believed that choice will lie between two of these, viz., the round, and the six or eight sided. In both of these kinds of tile the bore is round, and if made of equally good clay and well burned there is probably no great difference between them in respect to cost, convenience of laying and durability. As found in our markets, however, the six or eight sided tiles appear to be lighter in proportion to capacity than the round. This, of course, is an advantage in connection with transportation. It might be thought that the six and eight sided tiles, having flat faces, may be more conveniently laid than the round, which when placed upon a flat surface are more likely to roll. A highly convenient method, however, of preparing the bottom of a ditch for tiles is the cutting of a half-circle groove. Only this groove, which is to receive the round tile, needs to be graded with care and absolute exactness, and if the round tile be laid in such a groove the difficulty referred to is not experienced. Whatever the kind of tile selected the individual pieces should be straight, and the ends should be as square and true as possible. The tile should be hard-burned.

Both glazed and unglazed tile are offered in our markets. The latter, if well burned and of good workmanship, should make excellent drains, but glazing is likely to improve the tile in two directions. It makes the surface over which the water must move smoother, so that friction is reduced, thus giving greater capacity for carrying water for a given size, and the tile must prove somewhat more durable.

Special Forms of Tiles for Particular Uses.

There are a number of special forms of tiles for different uses. Among the more important are curves, enlarging tiles and junction or branch tiles.

Curves.

In ordinary land-drainage operations these are seldom necessary, but if for any reason the line of the drain must make relatively sharp turns, the work is more secure if the turn is made by the use of a curve of suitable character. It is a matter of some difficulty to make turns in lines of drains with straight tiles, and at the same time make the joints between abutting tiles sufficiently close to effectively exclude sand and silt.

Enlarging Tiles.

The enlarging tile is one that tapers, and such tiles are used when on any given line of drain a change is made from a smaller to a larger size.

Junction or Branch Tiles.

Such tiles are useful in making connections between lateral or branch drains and a main drain. Both Y and T branches are manufactured. The former are in most cases to be preferred. In order to procure when ordering the kind of Y needed the figure designating the diameter of the main drain should be placed first and connected by the sign of multiplication with the figure indicating the diameter of the lateral or branch tile which is to be united with the drain. For example, if a 2-inch branch is to be connected with a 4-inch main drain the order should read "1 Y, 4 × 2."

Collars.

Manufacturers of round tiles usually offer short sections for use at the junctions under the name of collars. Collars are usually about 2 or 3 inches long. The collar needed in any case is a short section of tile just large enough to allow the insertion of the abutting ends of the tiles which are being laid. Such collars somewhat increase the security of the drain, as they reduce the chances that the tiles will get out of alignment. Their use, however, greatly increases the cost, and they are not ordinarily required.

How Water enters Underdrains.

Two misconceptions as to the manner in which water enters underdrains appear to be not uncommon.

1. There is a general idea that special provision for the entrance of water must be made, like that, for example, between stones in drains of that type, or that, in the case of tile drains, the tile should be porous in order that water may find its way through.

2. It is thought that water runs down from above into the underdrain.

As a matter of fact the underdrain is brought into action only when some portion of the channel for water is below the water table in the soil. However rapidly water is carried into the soil, the underdrain will not run until the level of the hydrostatic water in the soil rises above the bottom of the channel which the drain affords. As the hydrostatic water rises above the drains, the water, by its natural hydrostatic pressure, is forced into the channel afforded by the drain. The pressure increases of course as the water rises, and before it has risen much above the channel it is sufficiently great so that, practically speaking, however impervious the tile, or however close the joints (if laid without mortar), it is impossible to keep the water out.

In putting in underdrains we have not to consider in the case of either tiles or stones the provision of openings through which the water will enter; on the contrary, we must use every care to make all joints just as close as possible. The danger is not that the water will be prevented from entering, but that foreign substances (fine sand and silt) will gain entrance and thus obstruct the drain.

The Location of Drains.

The location of drains in a field requiring drainage should in all cases receive special and careful attention and study. It is not possible to lay down general rules which will prove of much value. In the case of large operations there must usually be a principal or main line and subordinate branch lines of drains. The principal drains are usually spoken of as mains, and these will naturally run through the lowest part of the area to be drained, while with both mains and submains, branch lines, which are usually spoken of as laterals, will be connected. In planning a system of underdrainage it seems to be wise to provide for a system with relatively few outlets into open water courses. Thus, for example, if we have a field with a principal channel running through it somewhere near the middle, and the land on either side slopes gradually towards this channel, the system will be most satisfactory if a main drain is put through the principal channel, and the laterals connected with it, only one outlet being provided for the entire system, which, of course, should be at the lower end of the main. In such a case good drainage might be secured by putting a

deep open ditch through the principal hollow, and making the laterals discharge directly into this; but while this system will cost less than the other, because the larger sizes of tiles needed for drains are relatively costly, it is not believed that it will prove equally satisfactory in the end, because the open ditch is liable to numerous accidental injuries (previously referred to) which may lead to the obstruction of some of the laterals. It will be much easier to watch and maintain in perfect condition the one outlet into an open water course on the main than to watch and keep in perfect condition the numerous outlets required if the laterals discharge directly into an open ditch.

Direction of Drains.

The proper direction of drains is determined by the slope. In all cases where the area to be drained is relatively level, it is necessary, in order to secure a satisfactory grade, to run the drains in the direction of the line of greatest slope. In the case of springy slopes, or slopes where water passing through the soil tends to continually crop out at the surface, running the drains obliquely down the slope is generally regarded as the best plan. In this direction they effectively cut off the water which is seeping through the soil toward the bottom of the slope, while at the same time they have a sufficient grade to carry the water away rapidly.

Laterals should as a rule run about at right angles with the main with which they are connected.

Proper Distances between Drains.

This will vary with the character of the soil. Laterals must be nearer together in proportion as the soil is compact and relatively impervious to water. In a field underdrained by parallel lines of tiles, the usual level of the water table along the lines of tiles will be the level of the bottom of the conduit which they afford, but as the distance in the direction of a right angle from the line of tiles increases, the level of the water table rises above the level of the conduit. The water table will be highest between any two lines of tiles along the line midway between them. The rate at which the water table rises is greater in proportion as the soil is compact. In a soil of open character the rate of rise is slight, and lines of tiles which are relatively far apart will hold the water table midway between any two lines at a level sufficiently below the surface of the ground. In a compact soil, on the other hand, the rate of rise of the water table is so rapid that should tiles be placed equally far apart the water would stand much too near the surface, perhaps at the surface, should the lines be placed equally far apart. In soils of the most compact character it is necessary, therefore, for the thorough drainage of soils naturally excessively wet, to place lines of tiles, which are not less than about 3 feet deep, at distances not greater than about 20 to 25 feet apart. Forty to 50 feet between lines is usually satisfactory.

In the statements which have been made concerning the distance between different lines of drains reference has been made to the drainage of areas where soil and water conditions are uniform in character. There are, of course, many fields with varying soil and water conditions, in which uniform spacing of the lines of tiles is not advisable. Under these conditions each field is a special problem in itself.

The distance between drains which will give satisfactory results will be influenced much by the depth of the drains. The deeper these are the farther apart the lines may be. In compact clays a fairly safe rule is to place the lines 6 or 7 feet apart for each foot of depth in the drain, while in loams the distance may vary at double this rate. That is, it may be from 12 to 14 feet for each foot of depth.

The Proper Depth of Drains.

The depth to which drains can be placed is in some instances determined by the level of the water in the open channel into which the tiles must eventually discharge. Where this level is relatively close to the surface, the question will sometimes arise with how little depth may fairly satisfactory results in drainage be anticipated. In the writer's judgment it will not be advisable to put in underdrains unless the depth possible is equal to at least 2½ feet from the surface. Here and there for short distances the tile may be laid at less depth, but it will not be safe, from the action of the frosts, at less than the depth indicated.

In all cases where conditions permit it seems best to place underdrains at the average depth of from 3½ to 4½ feet below the surface. At this depth drainage in the case of compact clays and hardpans may be relatively slow at first, but later the soil will gradually become more open and porous under the influence of root action, the tunneling of earth worms and the formation of cracks as the soil dries out, so that, in the course of a relatively short time, the drainage of even clays is sufficiently rapid with underdrains at the depth indicated.

The Proper Grade.

In the case of fields which are relatively level it is necessary to consider with how small a grade satisfactory drainage can be secured. Experience indicates that with very careful work satisfactory drainage is secured with grades not exceeding 3 inches in 100 feet; indeed, engineers often put in drains with less grade than this. To put in drains which will work satisfactorily with so flat a grade requires extremely careful work, and with the kind of labor usually available on the farm, even under the careful oversight of the owner, who in most cases will have little experience in this kind of work, a steeper grade will be much safer. With ordinary skill and care excellent work can be done with grades ranging from 3 to 5 or 6 inches to each 100 feet. Whatever the grade, much care should be taken to make it as uniform as possible.

THE SIZE OF TILE TO LAY.

The amount of water carried by tile of any given size varies with the grade. The area of the circle which measures the bore varies with the square of the diameter. It may appear, therefore, that at a uniform grade the application of this rule will indicate the relative capacity of different sizes to carry water. Thus, for example, it might be supposed that the 3-inch tile would carry two and one-quarter times as much water as the 2-inch tile because the square of 3 is 9, and 9 is two and one-quarter times 4, which is the square of 2. As a matter of fact, the 3-inch tile will carry more than two and one-quarter times as much water as the 2-inch, because the amount of friction is relatively greater in the smaller sizes. Friction being taken into account, tiles of different sizes, according to Wheeler,[1] have about the following relative capacity to carry water, as compared with 2-inch tile taken as a basis of comparison: —

2½-inch tile	1.5 times the water carried by 2-inch tile.
3 -inch tile	2.5 times the water carried by 2-inch tile.
4 -inch tile	5.0 times the water carried by 2-inch tile.
5 -inch tile	7.5 times the water carried by 2-inch tile.
6 -inch tile	12.5 times the water carried by 2-inch tile.
8 -inch tile	25.0 times the water carried by 2-inch tile.

(*a*) *Size for Laterals.* — Throughout the eastern States 2-inch tile is most commonly used for laterals, but in the middle and western States larger tiles are usually employed. Chamberlain says: —

> The tendency toward larger size, especially in the rather level prairies of the west, is manifest and wise. The soil is more porous, and hence laterals may be much farther apart, and wisely laid deeper (even 4 or 4½ feet), than in our more compact, clayey soils in Ohio. Also, as the grades there are less, the sizes must be larger. . . . In Illinois 3 and 4 inch tiles are now the smallest sizes found at most tile kilns. The material is not expensive, and the tendency toward large sizes is wise, except where freights or long hauling make the weight important.

(*b*) *Size needed for Mains.* — Chamberlain has given rules for the size of mains in tile drainage which appear to be worth stating. According to his rule, to determine the number of acres that can be drained by tiles of different sizes when the grade is not more than 3 inches in 100 feet: square the diameter of the tile and divide the result by 4. It will be found that the areas drained by different sized mains according to this rule will be as follows: —

3-inch tile,	2¼ acres.	5-inch tile,	6¼ acres.
4-inch tile,	4 acres.	6-inch tile,	9 acres.

[1] Hints on Land Drainage, Agriculture of Massachusetts, 1895.

When the grade exceeds 3 inches in 100 feet the diameter should be squared and the result divided by 3. This gives the following results: —

3-inch tile, . . . 3 acres.	6-inch tile, . . . 12 acres.
4-inch tile, . . . $5\frac{1}{3}$ acres.	8-inch tile, . . . $21\frac{1}{3}$ acres.
5-inch tile, . . . $8\frac{1}{3}$ acres.	

Wheeler has given rules which accord closely with the rules given by Chamberlain.

(*c*) *Method of Determining Area.* — Wheeler, however, has pointed out that owing to the fact that water more slowly finds its way to the drains in compact soils, the area satisfactorily served by a main of any given size is greater in such soils than in those of more open character.

Laying out and Construction of Drains.

In all cases where the grade must be flat it will be wise to employ the services of an engineer with accurate leveling instruments. Such services will cost something, but the expense of expert services would be amply justified in the more accurate and better work which can be done. At the outset, beginning where the main drain will discharge into the open water course, stakes should be put in at each end of each line of drains, and at all intermediate points where the direction or grade changes. Beside each stake drive a grade peg or hub, level with the surface of the ground. On each of the reference stakes first driven mark the depth at which the drain is to be laid below the top of the grade peg. When ready to begin excavation drive a pair of stakes, one on either side of each peg and a sufficient distance apart to clear the ditch when it is opened. Across each pair of stakes nail a batter board, the top of which should be at some uniform distance above the proper grade at the bottom of the ditch, — 6 feet is a convenient distance. For example, if the figure on a given reference stake indicates that the ditch is to be excavated 3.8 feet at that point, the top of the batter board should be 6 — 3.8, or 2.2 feet above the top of the hub. If the figure on the reference stake is 4.2 feet, then the height of the top of the batter board should be 1.8 feet above the top of the hub. When the batter boards along any given line are placed the excavation may begin. It is best in almost all cases to begin at the outlet or lower end of the line, and in most cases it is best to begin laying the tiles also at the lower end. A convenient means of determining whether the ditch is just the proper depth at any point is to stretch a light and very strong cord over the tops of the batter boards, immediately above what will be the center of the bottom of the ditch. The workman who finishes the grading should be provided with a measuring rod 6 feet in length, and should excavate until the distance from the cord above his head to the bottom of the ditch is exactly 6 feet at every point. There is one rather serious danger connected with

the use of such a cord. It may sag between supports. It is necessary to take the utmost care to see that it is perfectly taut and in the true line of grade.

If in excavating the ditch earth of different grades is found, it will be best to throw that which is coarsest by itself, as such earth is best suited to fill immediately around and above the tile. In clay sands or soils made up very largely of silt and extremely fine sand, it will often be profitable, if the distance which it must be carted is not too great, to haul coarse sand or fine gravel in order to fill in immediately about and above the tiles. If soil made up either of quicksand or fine silt be placed next the tiles it is almost certain to wash in at the joints. In all cases where the bottom is quicksand, or soft and treacherous in character, it will be best to place slabs or boards in the bottom of the ditch and to lay the tiles on these. In laying the tiles the utmost care should be taken to make as close joints as possible. Considerable security against the entrance of silt and fine sand is secured by carefully covering the joints between tiles. For this purpose tenacious sods, placed with the grass side against the tile, are often effective. Other materials which prove effective are strips of tarred paper, about two or three inches wide and long enough to reach around the tiles, or similar strips of burlap, — old fertilizer sacks cut or torn up answer this purpose admirably.

As soon as possible after the tiles are laid the earth should be filled in, for until this work is complete there is danger of serious damage through washing and caving should excessive rains occur. Care should be taken in filling to compact the earth thoroughly, and to round it up immediately over the line of the drain.

Many authorities recommend putting in silt basins at the junction of laterals with main drains and at points where there is a change in direction. In the writer's experience such basins add considerable to the expense, and are in many cases somewhat difficult to keep in repair. He does not, moreover, regard them as essential, and would advise putting them in only at important points in the system. The simplest method of making a silt basin is to use vitrified sewer pipe set with the lower end about one foot below the level of the tile. The drains are led into and out of it through holes of suitable size, which may easily be cut through the sides of the pipe. A second length of pipe may be set over the first if the depth requires, but the author would advise against carrying such wells to the surface. He would have the upper end of the well at least a foot below the surface of the ground. This must be covered to exclude the earth which will be filled in above it, and for this purpose either a cast-iron cover or a flat stone will be best.

The location of a well may be marked by a stake driven beside it, or it may be indicated on a plan, which, indeed, it is always wise to make and preserve for future reference whenever underdrains are put in.

ARTIFICIAL HATCHING AND REARING OF CHICKENS, AS APPLIED TO "SOUTH SHORE ROASTERS."

BY HENRY D. SMITH, ROCKLAND, MASS.

The hatching and raising of chickens artificially has been practised for ages, but the last decade has been marked with the greatest strides, as is shown by the vast number of incubators and brooders that are being made daily by the various manufacturers, all of which are being sold and used, which means that the poultry industry is still growing.

The question is often asked, "With all of this increase in the production of poultry products, is not the time near at hand when the poultry business will be overdone?" The reply is, "*No,* not as long as the demand increases as fast as the supply." And to-day Massachusetts is only producing about one-fifth of the poultry products that she is consuming, and again, while the price for spring roasters has not been any higher for the last two years than formerly, it has remained high for a longer time, which is just as good if not better for the poultryman.

To illustrate the importance of artificial methods in the hatching and rearing of chickens, just imagine our going back to the old hen for an incubator and a brooder! We might as well go back to the ox team for our transportation, and discard the steam and electric cars as well as the automobile and the flying machine, which is almost here.

With all of the incubators mentioned above going broadcast all over the country, into the hands of the novice as well as the expert, the question very naturally comes up, "Just what is the proper method for operating an incubator to get the best possible results?" In considering this question we must assume that the eggs are from good, strong, vigorous stock, which means not only stock from good parents, but those that are fed properly and comfortably housed. Almost any good variety of grains thrown in the litter of from four to six inches deep every morning (three parts of corn, one part each of wheat, oats and barley, makes a very good mixture), with a so-called dry mash, composed of equal parts of ground oats, middlings, Indian meal and beef scraps, until the hens get to laying well, then reduce the scraps to one-half of a part, makes a very good feed. The dry mash is practically

before them all of the time in troughs or hoppers, and of course plenty of good water, shells, charcoal and plenty of green stuff in some form, — clover, alfalfa, rowen hay, cabbages, mangels, beets, or any of the many things that are the most available about the farm. Then the eggs should be gathered at least once a day, and in cold weather often enough so that they do not get chilled, every egg being marked with the number of the pen in which it was laid, so that when there are sufficient eggs to set a machine, a record can be made of how many eggs came from each pen.

In starting the incubator, the manufacturers' directions are sufficient, and their instructions for operating are as good as can be given in a general way for all parties and all conditions; but right here is where the difficulty, the mystery, and all of the varied opinions and controversies begin. If it were possible to have the very same conditions in every one's incubator room, the same instructions would apply to all; but until then, no rigid, fixed, arbitrary rule can produce the best results. To illustrate the different conditions that it is possible to obtain, divide the humidity into the following classes, — very wet, wet, damp, normal, dry, and very dry; then divide the ventilation into very poor, poor, fair, good, and very good; then make as many divisions of the temperature, from freezing to 85° or 90° above; now figure up the number of combinations that there are in all of the above features, and see what the little, insignificant embryo chick must contend with before the operator begins to manipulate the machine at all.

In starting an incubator, the best thing to do — and it is not difficult — is to follow the manufacturers' directions, and then by careful experiments, and records of them correctly kept, ascertain just how the best results can be obtained under one's own conditions. Now this seems to leave the party seeking information right where he began, but it does not if he thoroughly "digests" it, or grasps the writer's idea. Suppose a party buys his first incubator, and before starting it he goes to half a dozen different poultrymen, all equally successful, and finds out just how each one is running his machines; the chances are more than even that there will not be two of them that are doing exactly alike, and the party finds himself more bewildered than ever, when as a matter of fact they have all been honest with him, and are doing the very best that can be done under *their conditions*. For instance, one may run his as high as 104°, and perhaps is "airing" or "cooling" the eggs a great deal; where another may run his from 102½° to 103°, and is not airing his eggs at all; again, one may not supply any moisture at all, where another will be sprinkling them twice a day; and another has a wet sponge or some water pans in the incubator, or a wet blotting paper around the heater, and another will wet the floor down *wet;* then there are all kinds of ways of ventilating both the incubator and the room, so that I will have to reiterate, as above, that there is no one rule that will apply to us all.

Plate 1. — Interior of Brooding House.

With all of the above explanations, so that no one will be misled, I will now try to explain what my conditions are, and how I handle my incubators. The cellar is 12 by 26 feet, and 5 feet deep to the top of the stoning, and the roof sets right on the stone work. The floor is not cemented, as the tendency would be to make it too dry, and we intend to keep the floor good and damp all of the time. The roof is sheathed up on each side about 4½ feet on the rafters, then level across the top, thus forming an air chamber, which helps to maintain an even temperature in the room. For ventilation there is an imitation fire-place in the stone work at one end, which leads up to a wooden chimney, and there is on this same end a window 30 by 30 inches, which is always open excepting in a driving storm, or when it is so cold that the incubators cannot be kept up to the proper temperature readily; the entrance is at the other end, with a door at the top and bottom of the stairs, each door having a slide 8 by 12 inches, which is used for more ventilation, and there is a small ventilator out through the roof. There is no heat supplied other than the incubator lamps.

In this room there are eight No. 3 Standard Cyphers Incubators, holding from 380 to 400 eggs each, according to the size of the eggs, of the 1906 and 1907 patterns, having the drawers for the chicks to drop into after they are hatched, and the drop bottom; and they also have an electric light placed close to the thermometer, so that the temperature can be read easily and correctly. The temperature is then brought up to 102½° and the eggs put in, which will bring the temperature down again, but when it gets up to 102½°, which it should do in less than half a day, the ventilating holes in the bottom of the machine are opened. The lamp is filled and the char rubbed off (not trimmed) of the wick, and any black incrustation that may have accumulated on the burner scraped off every day; and if the porous brass plate around the wick tube gets fouled up, that must be taken out and thoroughly brushed off.

The eggs are not turned the first two days, but after that they are turned night and morning every day until they begin to pick the shell, excepting the days when they are tested. The heat is not allowed to get above 103° during the first week, but during the second week it will naturally rise a little, owing to the animal heat that will begin to develop in the eggs; but if it goes much above 103°, take the eggs out, or leave the door open and cool them down again. About the time they begin to pick out, if the heat goes up to 104½° or 105° of its own accord let it remain; but if it goes any higher, bring it back with the regulator, but do *not* open the door.

The chicks are not allowed to drop down into the drawers until they are nearly all hatched, as there is quite a difference in the temperature in the two places, and by keeping them up on the tray until a good part of them are thoroughly dried off and smart, then the smartest ones will come to the front, and so many of them drop down in so short a time that none of them get injured by the change of the temperature,

as they keep each other warm. The door is not opened until the morning of the twenty-third day, when they are taken to the brooder, and the machine cleaned up thoroughly and set again.

Before putting the eggs in the incubator, they are all sorted out according to the number on each egg showing the breeding pen that they came from, and a record is kept of how many eggs are set from each pen, so that when they are tested, those that are thrown out can be sorted and set down in another column. The first column has the number of the pens; the second, the number of eggs from each pen; the third, the number of unfertile eggs; the fourth, the number of germs that started, but are dead or "addled" eggs on the first test; the fifth, those that are dead on the second test; the sixth, the eggs that do not hatch; then, by adding all of the eggs that are thrown out from each pen and subtracting them from the number of eggs set in column 2, we have the seventh column, which shows just what each pen of breeders is doing.

If a certain pen's eggs are not fertile, change the male bird at once, giving the first one a rest, when he may be used later on to take the place of another who is becoming exhausted. In changing the male bird, which is one-half of the flock, as far as fertility is concerned, we have done about all we can for this feature, unless it is to change again; for, although it is sometimes argued that the hen may be to blame, or her condition, it is safe to assume that a hen that is in good enough condition to lay is pretty likely to be in good enough condition to give you fertile eggs; but if the fourth, fifth and sixth columns show that too many of the fertile eggs fail to hatch from any particular pens investigate at once, and see if the flock is healthy, are properly fed and cared for in every way; but if this trouble happens with all of the pens, buy some eggs from some one who is getting good hatches, and then one can easily determine whether it is the fault of the eggs or in the process of incubation. If it is found to be in the incubating, "go for it," and find out, by a systematic plan of experiments, just which of your conditions or what you are doing is wrong. Stick to it, — that very "stick-to-it-iveness" is what has been ascribed as the secret of the writer's success.

Make the first test on the fifth or sixth day, and the unfertile eggs will be in good condition for all cooking purposes, and are worth from one-half to two-thirds the price of market eggs; there is also more room and the eggs can be turned more easily. The second test can be made about the fourteenth day, and if all the dead ones are thrown out, there will be very few if any that will be rotten and smell bad; and by carefully studying the records of both tests, one can keep in touch with just how the process is progressing.

To make a good tester, have a window that faces the sun fitted with a board having a hole in it, the same as any tester, with a piece of felt or leather around this hole, and then darken the rest of the room so that all of the light must come through the egg when placed against this

Plate 2. — Outside of Brooder House in Winter.

hole. With this arrangement, and a bright sun, no explanation of how to test is necessary, for after one has tested a dozen eggs he can tell as well as any one what is the condition of the eggs.

Under the above conditions the airing or cooling of the eggs is not practised, except when they get too warm, the theory — and it is well borne out by experiments — being that if the room is well ventilated, so that the air is kept good and the proper temperature maintained, the embryo gets all that is needed through the natural circulation that is taking place in this kind of an incubator all the time. On the other hand, if the air is so vitiated that it feels close or "stuffy," and smells strong of the fumes of the lamps, and so that one is glad to get out after staying in there a few minutes (and many of the incubator rooms are in just this condition), and the air in the incubator cannot possibly be any better, in fact, not as good as the air in the room, it is quite likely that a reasonable amount of *airing* is beneficial, but *not* the *cooling*, unless the temperature is too hot. There is no question but that the embryo chick needs oxygen, and that being an accepted fact, it must be far better to give it good oxygen all of the time than to give it inferior oxygen, and in spasmodic doses, at that. It makes quite a difference, too, in what temperature they are aired, as well as at what stage of the process; for to air them considerably where it is not too cold, during the last week, will do no harm, and under some of the above conditions will be of benefit, but to air them during the first week is a great mistake, especially if the temperature is anything but warm.

The writer has been called many times to help poultrymen out of different kinds of trouble, such as, Why do we not get better hatches? Why do so many die in the shell? Why do they die so after we get them in to the brooder? One of the most pronounced cases of the ill effects of airing and cooling was where a party began to air the eggs on the third day, where the temperature of the room was just 50° F., for fifteen minutes, and I think twice per day at that, and this in a room where the ventilation was very good and they did not need airing at all, and certainly did not need and could not stand the cooling, for out of 8 fertile eggs tested on the seventh day there was but one live germ, and out of several hatches of 30 dozen eggs each he got less than 1 dozen chicks per hatch. Through my advice he stopped the airing scheme, and out of the next hatch he got 108 chicks from 180 eggs, and 43 from the other 180 eggs, and from this experiment he also learned that there was trouble in the flocks that the 43 chicks came from. Now, there is another who has derived more or less benefit since he began to air the eggs, and a comparison of the conditions will easily show why. In the first place, the ventilation is not near as good as that of the first party, and then if the room is too cold he has a little stove to warm it up. This is all now on the cooling practice, but when we come to the brooding and rearing of the chicks I will refer to it again.

To illustrate the difference in conditions, I will quote from one more of my visits, where the party was not satisfied with his hatches. He had an incubator cellar, stoned up to the roof, with three small windows, about 10 by 20 inches on each side, but those on the lee side were the only ones that were ever opened, and those only a little at the top, and this was all the ventilation there was; there was also a cement floor, which made it very dry. In this room there were some 18 incubators, and, while everything was kept nice and clean, one was very glad to get out and get a good breath of fresh air. The same party had 6 incubators in a very damp cellar, with not much provision for ventilation, but it was very large and roomy, and he had not taken off any hatches from these machines; but the writer told him at once that this was the place to hatch chickens, the other place was too close and too dry, and it proved just so. So it is very plain that one must learn just what is best to do under his own conditions. This is not to be construed that one is not to get other people's ideas, either verbally or through the papers, — do so by all means; but also learn what their *conditions* are, then take them home and apply them if necessary.

In the artificial rearing of chickens by the amateur there are many obstacles if he undertakes to work them all out himself; but if he so elects, he has many advantages over the beginner of fifteen or twenty years ago, because where he has a chance to imitate, the other had to feel his way in the dark and make many costly experiments; and even now, while there are plenty of parties that are successful in this business, making a good thing out of it, it is very doubtful if there is one single party that is all through experimenting and trying to do better, which simply shows that there is still chance for improvement.

The first requisite in the artificial raising of chickens is the brooder; and when one considers that the most important factor that brought the chicken into this world as a living being was *heat*, and that that heat had to be about right in order to produce a strong, healthy chick, it will be easy to understand that the temperature in the brooder must be about right to have the chicks live and do well, because that important factor does not cease as soon as the chick gets out of the shell but remains in full force for several weeks. No one would think of taking a little chick out of an incubator, where the temperature is above 100°, and turning it loose to shirk for itself with no old hen to cuddle up to, to warm itself; so it was necessary that some way be devised to supply the proper heat. But the next question is, What is the proper temperature, and how shall we provide it? The writer works on the plan that, if there is a suitable place provided that is a little *too* warm, and if the temperature is gradually and continuously decreased to a place that is *too* cool, the chick will instinctively find the place that is just right, providing it is healthy.

Plate 1 shows the interior of a 60-foot brooding house. It is 14 feet wide, 6 feet 3 inches high between a cement floor and plastered ceiling,

Plate 3. — Colony Houses in Winter.

has a walk on the north side 33 inches wide, and is divided into 10 pens, with a window of 9 by 13 glass to each pen on the south side. There is a ventilator 7 inches square over every other dividing fence, making 5 in all, which just reaches through the ceiling, then the space above the ceiling has two ventilators 16 inches square out through the roof. The board partition between the walk and the pens is 30 inches high, and just in front of this are the hot-water pipes and in front of these are the return pipes. These pipes run the whole length of the house through the pens, and are 6 inches above the cement floor; they are supplied from a heater that is at one end, down in a pit that is 4½ feet deep and about 7 feet square. An even temperature is maintained by an electric regulator that will open and close the drafts automatically, within 1° of a given point; and if for any reason the temperature gets too hot or too cold, it rings a bell in the attendant's room. For instance, the fire may get low, or a door blow open, or a window drop down, or the attendant may neglect to wind up the machine, etc., but with this arrangement he is notified before any damage is done.

Coarse sand or fine gravel is put all over the floor and up to within 2 to 3 inches of the pipes, and the temperature in this space under the open pipes is kept at 90° F.; but for the first ten days there is a cloth frame 30 inches square laid over one end of the pipes in each pen, for the little chicks to have a place where there is no draft, and the temperature will run up to from 95° to 97° under this cloth, with the temperature at 90° under the open pipes as above. This makes a place that is a little too warm, and as the chicks grow older, so that they do not need so hot a place, they will work out under the open pipes, where it is 90°; and when this is too warm they work out under the returns and from here just out in front of all the pipes, and so on by their own instinct finding the heat that just suits them, and there is no incline or stairs for them to learn to climb, or stay out and get chilled, but the whole width of the pen is heated, and is wide open for them to go where they please. During the first four days there is a board put clear across the pen about 1 foot in front of the pipes, and wide enough to reach from the sand up to 3 to 4 inches higher than the pipes; this prevents an undercurrent of cold air from drawing in under the pipes, right onto the young chicks, which is more than they can stand. As the heat is generated in the pipes, and rises at once, the cold air rushes in to take its place, hence this undercurrent. After the first four days this board is moved away a little every day until about the seventh day, when it is taken away entirely. In one of these pens, 6 by 11½ feet, are put from 100 to 125 chicks right from the incubator, and they are kept there until they are feathered out enough to go out to the colony houses, where there is no heat.

The little chickens are fed sparingly, yet enough, five times per day at first, with any good mixture of fine grains and seeds that has a good variety, such as the Cyphers Chick Feed, scattered all about, and a dry mash composed of two parts of bran and one part of Indian meal,

and a few beef scraps. The dry mash and beef scraps are fed on a board 12 by 24 inches, with a lath tacked around the edge. Then of course they must have plenty of good water, and if the sand is right they will get what grit they want out of that, and they must have some sort of green stuff, it does not matter much what, so long as they eat it. Under the above arrangement they have the whole run of the pen after they are a week old, and then the first fair day they are allowed to go out doors a little while each day, and in a few days more, according to the weather, all day.

Plate 2 shows the outside of the brooder house in the winter time, with the windows dropped a little at the top, opposite the pens that have the oldest chicks. Plate 3 shows the colony houses, with snow on the ground also, and they have 6 by 8 foot sills, with a front of 5 feet and the back 3 feet high. There is a self-feeder inside that holds a bag of cracked corn, a box for scraps, another for shells and grit, and a one-half size bucket for water. Fifty chicks are put into each, right from the brooder, and kept there until they are sold as roasters, having a run large enough so that they do not kill the grass.

One of the greatest obstacles in the rearing of chickens artificially is what is known as the "white diarrhœa," and the writer had it here for years, but not for the last three seasons. If the temperature during the whole process is kept where it should be, from the time the eggs are put into the incubator until the chicks are three to four weeks old, there will be no "white diarrhœa." If one will notice how the chicks are taken down, it will be found that they do not eat as much as they should, but drink a great deal of water, which shows that they are feverish, and this is either caused by a lack of sufficient warmth or because they have been chilled.

Then comes the question of what is the proper heat in all of the different stages of the process; and about this time there is another element that enters in, and that is, if a chick comes into the world in a good, strong, vigorous condition, it can stand considerable ill treatment; but if it is not very strong, perhaps has not had just the right heat in the incubator, or the old stock was not just right, and yet it is possible to raise it, *with the right kind of treatment*, it must have a chance to get where it is warmer, if it wants to. The cooling process referred to under the head of incubation can be carried to such an extreme that will produce just this trouble, and then there are several ways by which it can be brought on in the brooder. One way is to run the heat too low all of the time, and in this last case it need not be much too low, either; then it may be run warm enough practically, but the fire goes out, and the longer it remains out and the lower the temperature goes the more likely they are to receive the chill necessary to bring on this trouble; and again, the younger the chick the greater the danger. Then there are brooders that are so constructed that the little chicks do not know enough to find the place where the proper heat may be, after they are once let out; and one will often see them

in various numbers, huddled up in some corner trying to keep each other warm, which means white diarrhœa in a few days. In this last instance it may happen that only a few get chilled, and they may be the only ones to have it; then, if the party has used some concoction as a remedy, he may think that the remedy was what cured the rest of the lot, when as a matter of fact they never had it at all. So the best remedy is to give them a chance to go to any temperature they want, and so arranged that the little chicks right out of the incubator cannot help finding it, — in other words "fool proof."

The question is often asked, "Is there a chance for me to get a living in this artificial chicken business?" The reply is, "There certainly is," for the right party; and there are very few if any other kinds of business that offer as large returns for the amount of capital invested. But when the question is asked, "Can *I* make a living at it?" it is quite another thing, for no one can tell another whether he can make a success if he goes into any kind of business, — chickens, dairying, sheep raising, manufacturing shoes, stockings or watches, because so much depends on the person himself. If one has but little capital, he must work, and work hard, until he gets everything to do with, then it will go along very easily; but if one has money enough to hire all the hard work done, of course it is just so much easier.

There is one thing that would be of inestimable value and help to the poultrymen of this State, and that is, to have a Massachusetts Poultry Association, one such as every one who is interested in any branch of the business, and even their friends, would be glad to join, that we might work together for the common good of the whole poultry fraternity. For an idea of the many things that might be accomplished, the reader is referred to the Connecticut and Rhode Island Poultry Associations, which have done and are doing a great deal for this important industry in those States. With a good, strong organization of this kind, we could go before the Legislature and expect to accomplish any reasonable object that we might desire; in fact, we could force the recognition that an industry of such proportions as this rightly deserves.

SOME SHEEP TOPICS FOR MASSACHUSETTS FARMERS.

BY RAY L. GRIBBEN, INSTRUCTOR IN ANIMAL HUSBANDRY, MASSACHUSETTS AGRICULTURAL COLLEGE.

Ranked among the other States of the Union Massachusetts does not find a place among the leaders as a producer of live stock, either in numbers, value or, in many cases, in quality. Through the development of the natural resources of the State in other lines than animal husbandry live stock has been compelled to find a humbler place. But even with these changes certain kinds of stock should not have fallen to so unimportant a place as they now occupy. Particularly is this true of the sheep industry, with which we are to deal.

At one time flocks of sheep were quite common in Massachusetts, wool and mutton forming a large item of the commerce of the State. When the Spanish noblemen, who for so long controlled the fine wool production of the world, were obliged, by the Napoleonic wars, to consent to the breaking up of their flocks, many thousands of them were exported to America. Vermont was the leading State in this importation, owing to the efforts of the minister to Spain at that time, a native of Vermont, but interest in the business speedily spread to other States. The earlier flocks were kept for their wool alone, a highly speculative product. When it ceased to be longer profitable the flocks were disposed of, and since then sheep have not been widely grown in Massachusetts.

Farm values having been materially increased since that time it is thought by many that sheep cannot be made profitable on such high-priced land. However, a study of conditions in England shows that sheep growing is there found profitable on lands much more valuable than those of this State, and feed stuffs are also usually higher in price there than here. The sheep growers of England have the advantage of skill and knowledge, but are successful because they are better managers and more careful feeders than we are. This skill can be easily enough acquired, and some other reason must be sought for the scarcity of sheep.

Many disadvantages must be carefully considered before going into the sheep business, chief among which are the ravages of dogs. The protection afforded by State laws is only partial, the damages received

not representing the value of the animals lost to the breeder, particularly where pure-bred sheep are kept. Much harm may be done in a single night by a worthless cur, and often the well-bred dogs kept by sportsmen are equally dangerous and determined in their work. For protection against this menace the best remedy is a well-trained Scotch collie, or other sheep dog. Fences, well made and high, form a fairly satisfactory barrier, but if these cannot keep out the marauder, a corral, into which the flock is driven every night, is the only protection.

The lack of fences is another drawback on many farms. Low walls, even if well made, form slight obstacles to sheep, and woven wire is ordinarily required. This can, if the walls are well laid, be made to go on top, so as to keep the sheep in, and, to quite an extent, the dogs out, by setting posts down the side of the wall and fastening the fencing to these above the top of the wall. On many farms the expense of this sort of fence would be heavy, because there would be division fences between the different fields. Movable hurdles may often be used when desired to pasture the ewes on rye or other green forage, in the "flushing" season, or when the permanent pasture becomes short in feed, and such hurdles are less expensive than permanent fences around all fields.

More losses in the whole country are annually caused by parasites than by dogs, wolves and thieves. The pastures become infected from the droppings of the sheep, and where the surface drainage is poor, or a low pasture receives the drainage of surrounding upland pastures, infection is very probable. Sheep are close grazers and so are more liable to such infection than other kinds of stock. Drinking water from standing pools in the pasture is another prolific source of infection. The parasites affecting the alimentary canal are those most dreaded by flock masters, among them being the stomach worm, the liver fluke, the hook worms, gids, etc. By rotation of pastures, using upland, well-drained fields, and allowing only running streams to furnish water supply, serious trouble may be prevented.

Another dangerous parasite is deposited in the nostrils by flies, in the larval form, and gradually works up the nasal passages, and sometimes into the brain cavity, where it begins to grow. Lime given the sheep in their grain causes them to sneeze, thus dislodging these larvæ. Holes bored in timbers, with salt deposited in them and the edges smeared with tar, are also used as preventives, the noses of the sheep becoming smeared with tar, the odor of which keeps the fly away from the nostrils.

All these obstacles can be easily overcome if due care is exercised in watching the flock, changing pastures and keeping up fences, — things which are, after all, but a small part of the flock master's work.

There is a great demand for pure meats of any description in the country at present, and New England is situated at a considerable distance from the sources of supply. The supply of sheep is at present

quite low, and packers have been obliged to kill stock only half fattened, "just warmed up," as the stock yard expression is, to fill their orders. The demand for mutton is enormous, and a fact which should be significant to Massachusetts farmers is that the heaviest and most urgent demands come from New England and the Middle Atlantic States.

It would not be wise to attempt to raise sheep in all sections of Massachusetts, and it is not likely that an immediate and complete change would be found possible in any case. However, the dairy business is not as profitable in many sections as formerly, owing to the high cost of feed stuffs, which has not been met by a corresponding increase in the price received for their products. In the hilly sections of the State, where the pastures are rather poor, considered as a range for other animals, sheep would do best. Here flocks could be established, which would do away with the farmer's dependence upon dairying. Sheep delight in browsing weeds and undergrowth, and are in their element where cattle and horses cannot thrive. In a few years' time they would bring these old pastures to the point where good pasture grass could grow, and make them more profitable than ever, particularly if they were given a little grain and clover hay while doing the cleaning up work.

Every farmer who does any general farming could easily raise a few sheep. Their advantages are easily seen, they do much of the cleaning up work mentioned above, and the wool which a ewe clips will often pay for her keep during the year. They can well be kept for the sole purpose of keeping the meat bill down, as they give a carcass which can be used before it spoils in the summer months, something that no other farm animal does, and the pelts of those so used may be sold to the hide man to bring additional income.

On farms where the owner desires to make sheep a chief industry there are only two principal lines that are profitable in the State, the raising of lambs for the early summer market or the production of winter or "hot-house lambs." It is not possible to buy lambs for feeding, native lambs not being available, and the cost on the nearest general market, Buffalo, being so high as to preclude buying them and shipping them to New England to fatten. Necessarily the only profitable meat production with our conditions is where the product is matured at as early an age as possible. The cost of grains is considerable, and the largest gains from a given amount are made when the animal fed is young. We must therefore get our product to market at as early an age as possible. It is not practical to keep sheep in Massachusetts for their wool alone, in fact, it was wool that destroyed the sheep industry in this State in the first place. Wool can be grown to a profit only on the western mountain ranges, where land is cheap, and where there is little competition with other more intensive industries. In choosing a breed for this State it would, however, be well to choose one which would shear as heavily as possible and yet not

interfere with its mutton-producing qualities. In other words, a mutton-general-purpose sheep is most desirable.

This brings up the question of what breed is best suited to the New England States in general and Massachusetts in particular. The considerations desired are a mutton sheep which carries a good fleece, both as to staple and quality. The fleece should be made up of wool which is most often called for in the market, so as to insure an easy sale at a profitable price. The quality of the mutton is also a point which merits attention. If a local market is sought, as is practically necessary, the quality of the meat must be high, the texture fine, fat well distributed, to give juiciness to chops and roasts, and the whole cut tender. Young animals usually give the most tender meat, and various breeds are noted for the flavor of their flesh. The prolificacy of the breeds is another point meriting consideration, since the farmers of this section must adopt intensive methods in all lines. A flock averaging a lamb and a half to a ewe is evidently more valuable than one averaging only a lamb to a ewe. Much depends upon the comparative strength of the lambs in the two cases, but as a rule those breeds which average as high as a lamb and a half per ewe bring forth quite strong and well-growing young. A further requirement is that the breed should be able to pick up a rough living on the hills and be adapted to the climate of the region. With these points in mind a description of a few of the more prominent breeds of mutton sheep will be given.

Mutton sheep are divided, according to the length of their wool, into two classes, — the long wools and the short, or, as they are more commonly known, the medium-wooled breeds. All of our mutton breeds came originally from England, noted as the greatest meat-consuming nation in the world, and where the people have a particular liking for mutton, even though noted as beef eaters.

Of the long-wooled breeds the three most important are the Leicester, Lincoln and Cotswold, and of the medium wools the Shropshire, Southdown, Hampshire Down, Oxford and Dorset are the best known and most valuable. The four first named medium wools are known as the "down" breeds, as they originated in the down countries of England, — in Shropshire, Sussex, Oxford and other counties in south-central England.

As a general thing the long-wooled breeds are the larger, and, as is true of most large animals when compared with those of the same species which are smaller in size, are slow in reaching their mature form. Add to this the fact that the quality of their flesh is not of the best, there being a tendency to coarseness in grain, the fibers of the red meat standing out prominently, like the fibers in the shoulder steaks of a beef as compared with the fibers of the loin cut of the same animal. With this coarse texture there is a tendency to a too uneven distribution of the fat, great soft bunches being likely to appear at the

tail head and down at the fore flank, giving weight to the animal but detracting markedly from the value of the carcass. Another characteristic of the long-wooled breeds which might be urged as an objection is that they are not as strongly prolific as the smaller varieties. Bearing these things in mind it will hardly be necessary to discuss their characteristics more in detail, and the principal characteristics of the smaller sheep will follow.

Of these none is so widely known throughout the entire country as the Shropshire. It is a fairly small breed, mature rams averaging 225 pounds and ewes from 150 to 160 pounds, sometimes reaching 175 pounds. It is about the average in size of the middle-wooled breeds, is a very squarely built and low-set animal, having abundant spread of rib, and carrying a thick covering of flesh on the back, loin and leg, those parts of most value on the carcass. From the back and loin come the chops, while roast leg is furnished from the hind quarters. A dense, fairly uniform fleece of medium length, averaging from two and one-half to three and one-half inches in length, covers the sheep.

A typical individual of the breed is low set, blocky, with level top and bottom lines, wooled well down to the feet, both in front and behind, with the belly well covered. No black wool should show on any part of the body, but the tips of the nose and ears are black in the best specimens. The wool should go well over the face, leaving only the tips of the nose and ears visible, the eyes being scarcely visible in many animals. The ears should have little tufts of fleece scattered about over their upper surface.

This breed is very popular as a general-purpose animal on account of its good size and fine quality of mutton and wool. Its early maturing qualities are first class, and are transmitted in large part to grade offspring. As grazing sheep other breeds may have wider adaptability, but in New England satisfactory results have been obtained in grazing them. The average percentage of increase among Shropshire flocks is nearly 150, or an average of a lamb and a half per ewe. Not every flock master can secure so high an average, but many have had even better results. It is as common a breed in America as any.

The Southdown is the smallest of the "down" breeds, averaging for the ram 175 pounds and the ewe 135 pounds, and is the oldest pure breed of the mutton type. It is even lower set than the Shropshire, and has as nearly a perfect mutton type, though on a small scale, as any of the so-called mutton breeds. It is so compactly made, and carries so much weight in such little bulk, that it is often described as the bullet type. For quality of mutton it is rarely surpassed, having an exceedingly fine flavor, with a large percentage of edible meat. In color the breed is of a rather grayish brown on the face, ears and legs, with a white fleece. There is a difference from the Shropshire both in length of fleece and distribution. The Southdown has a dense fleece, meaning one with a maximum number of fibers per square inch of surface, but it is considerably shorter than the Shropshire, there being

more difference in the average shear of the breeds. The Southdown has no wool below the eyes, except, perhaps, tufts similar to those on the Shropshire's ears, nor are the legs wooled so far down. An especially commendable characteristic of the breed in form is its unusually thick and plump leg of mutton. The breed is thick fleshed throughout and is early in maturity, though not quite so heavy gains can be averaged as with the Shropshire. The breed does well on hilly land, is fairly hardy, yet thrives best on farms similar to those of the corn belt. For wool production, even combined with mutton, one would not choose the Southdown, their best use being in mutton raising. Ewes are not up to the Shropshire in prolificacy, averaging only from 120 to 130 per cent in the best flocks. The breed is too small for the average farmer, and does not clip a heavy enough fleece to satisfy one who wants a general-purpose sheep.

A larger breed than either the Shropshire or Southdown, ranking next to the Oxford among the "down" breeds, is the Hampshire, — a breed in which the rams will average close to 240 to 250 pounds, and the ewes nearly 200 pounds. More upstanding than either of the smaller sorts previously described, Hampshires are not nearly as compactly built. A large, black face, with black ears held in a peculiar manner, the whole head set on the neck rather strangely, are distinguishing characteristics. The fleece extends down on the face, only a little below the eyes, does not cover the ears, and usually leaves the fore legs below the knees bare. As a wool producer their rank is not high, because of a rather open fleece, with short staple. The breed is particularly noted for large size of lambs at birth and their early maturity.

The largest of the middle-wool breeds is another "down," the Oxford, which averages about 275 or more pounds for the ram, with mature ewes above 200 pounds. This breed has a longer fleece than any so far mentioned, but it is not so dense. Many flocks of Oxford sheep average close to 11 pounds of unwashed wool per head. Ewes are quite prolific, but scarcely lead the Shropshires on this point. Heavy gains can be made with Oxford lambs, but they require a longer time to fully mature than some other breeds, and do not fatten quite as evenly as would be desirable. The Oxford is best suited to rich farms, where plenty of grain can be furnished, and must be given more protection than some of the other breeds. They resemble the Shropshire slightly, except for the larger size, larger head, clean face and longer, more pointed ears. Wool does not cover the legs so completely as in the Shropshire.

The Dorset horned breed is a white-faced, white-legged sheep, carrying a rather open but fairly long fleece, has quite good mutton type, though not quite so compact as the breeds already mentioned, but has peculiar characteristics which deserve mention. Rams average about 230 pounds, while ewes in fair flesh should tip the scales at close to 160 pounds, probably more. In quality of mutton they are some-

what inferior, not having so high a proportion of edible meat to whole carcass as the Southdown or even the Shropshire, ranking about medium in this regard. They are first class as early maturing stock and as wool producers. As feeders they do very well, standing pen feeding well and making rapid gains. In their native country they have long been famous for their tendency to breed at almost any time of the year; not only do they produce lambs twice a year if desired, but twins and triplets are fairly common. Of course in the winter lamb business one strong lamb is better than a pair of rather mediocre ones, quick growth being desired. The ewe will raise one lamb faster than two.

With these brief descriptions of the various breeds, serving as a partial guide for selection, the next step is establishing a flock. It is not necessary to build a new set of barns in starting in the sheep business, as many people imagine, the only shelter and protection required by sheep being dry quarters and sheds to protect them from cold, driving rains. A very economical way to start a flock is by the purchase of a few old ewes. Ewes of four to five years of age, if their teeth are still in fairly good condition, make a very satisfactory and yet economical foundation. They can be purchased from some large sheep breeder at a comparatively low price, because in a large flock it is best to keep only younger females, selling off the old ones after they show signs of poor teeth. It is not wise to attempt to save money on the ram in the same manner. "The sire is half the herd" is an old saying, as true as ever a proverb could be, but countless numbers of people go directly against the advice it conveys, and buy sires of a mediocre sort. With a herd of females of any sort the only way open for quick improvement is to purchase a sire that is better than the average of the flock. A good ram at a high price is cheaper than a medium individual at a low figure.

In the production of winter lambs more care should be taken in the selection of ewes than where the aim is to establish a good farm flock, as winter lambs must be very good individuals to command the best prices, and should come from young, vigorous mothers if they are to grow the best, make the quickest start and finish the strongest. The above method of securing a foundation flock can therefore hardly be recommended as a beginning for the "hot-house lamb" business, but for any other sort of market production it will be very practical.

With a pure-bred sire on average ewes the first lamb crop will usually be an improvement over their dams. Out of this lot come the individuals which are to replace the old ewes, which seldom retain their usefulness much longer. If some of the old ewes show vigor and health, and retain a workable set of teeth, they may be used as breeders for another season, after which they should be discarded, as by that time a sufficient number of younger females will probably have been produced to serve as the foundation of the permanent flock. The ram first purchased can be used on the old ewes, and, if a strong ram,

may be used on his offspring, provided they are exceedingly vigorous, but such use is rarely advisable. It is preferable to use another ram of even better breeding on the young ewes, and continue this process, getting as good a ram whenever needed as can be obtained. In this manner the quality of the flock will be continuously improved. It is their devotion to the highest grade of stock that has made the English breeders so successful, while our indifference to this point has prevented our attaining the same measure of success.

Ewes should be bred so as to drop lambs in March, or earlier if possible, because it is to the man first in the spring market with good lambs that the greatest profits go. Keep the prospective mothers in good condition before breeding, and if any appear thinner than is desirable, "flush" them with grain, as they breed better when in fairly good flesh, coming in heat more easily and conception being more certain. After turning the ram with them for a week or so separate them again and begin preparing for the lambs. A clean, dry shed, where the snow and rain cannot beat in, with openings and pens for exercise on the south, should be furnished for lambing. If lambs are due in February or early March a closed room, which can be artificially heated, will be the means of saving many a lamb that would otherwise become chilled and die. A breeding register is very convenient, and will result in saving a good many lambs that are dropped weak. If a breeding register is kept there must be some way of marking ewes as they are served. As convenient a way as any is to smear the belly of the ram with red paint or lamp black and oil, so that when the ewes are served some of this will rub off on the rump. Those served may then be cut out daily, and an accurate record kept of when the lambs should be dropped. Guess work is done away with at lambing time, and the ewes are not shut into the lambing pens until the proper time. A good shepherd will watch every ewe until she yeans, and will see that the lamb stands and takes nourishment before he leaves. This trouble is well paid for if only three or four lambs are saved, especially if intended for winter lambs, which often sell at from $6 to $8 per head at ninety days from birth.

After the birth of the lambs if the weather is severe and damp, as it sometimes is in February and March, the artificial heat should be kept up for two or three days, but after this period it is no longer necessary if the ewe and her youngster are removed to a clean, dry pen. The time when harm results from chilled lambs is immediately following birth, or when the little ones become wet in cold weather.

In preparing the lamb for market one should begin as soon as it is born. After parturition feed the ewe well, so as to induce a strong flow of milk. The more plentiful supply she has the faster the lamb will grow and the earlier he will reach the market. After two or three weeks he will begin to nibble at grain and eat small quantities. A "creep" should then be built, so that he may have access to finely ground grain, which should be of a somewhat different mixture from

the feed that the mother gets, consisting preferably of corn meal, bran and a small quantity of oil meal. The "creep" allows only the small lambs to get at this particular mixture. Corn has been proved by repeated trials to give the quickest results, as its fattening qualities, in conjunction with the mother's milk, give very quick growth. It should not be given alone on account of the heaviness of the feed, its effect on the digestive system, when so fed, being rather harmful. If a few roots — turnips or mangels — are available they make an excellent feed, and cabbages will produce very good results. Lambs do not eat much roughage, but will eat a little clover hay if allowed access to it. Being a protein fodder the clover hay will help considerably in the growth. It is essential in feeding young things of any sort to see that flesh-forming and bone-producing foods are fed, to supplement the fattening grains given. Feeds high in protein and containing considerable ash should be given, along with corn. Bran is added to the above mixture for that reason, containing a fairly high percentage of protein and being high in ash content. Oil meal contains a large amount of protein, and has a slightly laxative effect on the bowels, thus leading to a good condition of the digestive organs.

If good pasture is available little grain is necessary, but it should be given, even then, for stock that is being hurried to maturity. In early spring, when pasture is not plentiful, rye sown the previous fall makes good green fodder. Later on rape may be used to supplement failing pastures, but sheep should never be turned on rape when very hungry, because of the danger of bloating.

Docking and castrating may be done at the same or different times, as suits the convenience of the shepherd. In many instances docking is done first, and the castration when the lambs become stronger, thus not setting them back as much as when both operations are done at the same time. Early lambs, those marketed at from forty to ninety days, need not be castrated or docked. Those kept longer should be castrated, as their flesh becomes rather coarse in texture and has not so desirable a flavor if they are not altered. Undocked tails make sheep foul and unattractive, and for that reason should be removed from all except early lambs.

Docking may be done with a sharp knife, cutting off the tail about an inch and a half or two inches from the body. The division should be made at one of the joints for clean work and best results. Both docking and castration should be done when the ground is dry and the weather dry and moderately warm. Damp quarters tend to infection of wounds, and if the weather is good the stock will more easily and quickly recover than when cold, wet days are the rule. Both operations should be done when the lambs are but a few weeks old.

When young lambs show the presence of worms in the alimentary canal, causing severe emaciation, they are probably the stomach or other variety of the round worm. These may be gotten rid of by giving small doses of turpentine and linseed oil, being careful that no

portion of it enters the lungs, where it will cause death much more quickly and surely than can the stomach worms themselves.

Weaning may be done as soon as the ewe shows signs of a very much decreased flow of milk. It is not necessary to wean winter lambs at all, but those kept for later markets may be weaned easily and without much loss at from three to four months. Gradual weaning is best, instead of taking away the ewes suddenly. Lambs that before weaning have been fed the mixture of corn, bran and oil meal suggested above may be rapidly fattened on a mixture of two parts corn and one part linseed meal. If feeding for fall market, begin early enough to have the lambs well fattened before the pastures become so scant as to necessitate a change to dry roughage.

The ram to be used should possess good mutton type and be an impressive appearing individual, showing the leading characteristics of his breed. For some time previous to the breeding season he should be well fed on grain which is not too fattening. A highly fattened ram is poorer for breeding purposes than one in rather thin condition, and is not at all sure in such a condition. A standard grain ration is made up of oats and bran, fed rather lightly. Such feeds seem to improve the ram's condition, so that he is eager and sure and in full vigor, — conditions much to be desired. It is also essential in preparing him for the breeding season that he should have plenty of exercise. Good feeding without exercise spoils his usefulness, so that plenty of room for exercise should be provided under all circumstances. He may be housed during the day and allowed the run of a good pasture during the night, if one well protected from dogs is available.

The number of ewes a ram will serve in a single season, and insure good results, is of course dependent upon his age, vigor and management. A vigorous ram, allowed to run loose in a large flock, will no doubt serve more lambs than is best for his own constitution and for the lambs to follow. An average mature ram, running at large with the flock during breeding season, should not be expected to serve more than 30 or 40 ewes. A lamb ram should not be allowed more than 15 or 20 females, a yearling or "shearling" ought to be confined to not more than 40, and 60 ewes is the outside limit for any vigorous and mature lamb if best results are desired. Between the ages of two and six years a buck is in his prime. With the ordinary flock in this State it is as good a plan as any to turn the ram with the ewes when the breeding season arrives. If he has been fed grain liberally before the breeding season a slight grain ration should be continued if possible, but he will do well on pasture alone. After the ewes have all been bred the grain ration should be cut down gradually, and the ram eventually allowed to pick his living from pastures and roughage, taking care not to starve him, as many do.

Ewes should be bred to drop lambs as early in the winter as accommodations for taking care of them are available. If the farmer has no sheds which are dry, and is without one or two rooms which may be

artificially heated on severely cold days, it is useless to think of producing February lambs. Early lambs are desirable, as they may be marketed before the hottest weather, when infection and loss from parasites are most likely, and the early market is also the best. A good fall market may be had also, but in breeding for the fall market considerable more care and risk will be incurred in carrying the animals through the summer than if they are sold before the latter part of June, coming chiefly from internal parasites, as the stomach worm.

Winter Lambs.

The term "hot-house lambs" is misleading, as most people imagine that their production requires extremely artificial conditions, which is not true in the sense they mean. The conditions required are not nearly so artificial as are furnished dairy cattle and horses. The "hot-house lamb" is simply a lamb born in November or December, fattened and sold during the first ten weeks of the new year, when there is a strong demand for choice lambs from 45 to 60 pounds in weight. They will bring very favorable prices, often averaging from $8 to $10 per head, and the demand is always stronger than the supply. The chief markets are in the larger cities, so the selling must either be done through commission men or a fancy private butcher trade built up. If possible, it is desirable to deal directly with some large market, or to furnish hotels with lambs direct from the farm.

In producing "hot-house lambs" immunity from parasites is obtained, thus avoiding one of the most serious handicaps of the business. The lambs suffer from parasites more severely than their dams, being young and comparatively weak, but winter lambs cannot suffer, as it is when feeding in pasture that the parasites obtain a foothold. The winter months are, as a rule, a time when work on the farm is somewhat slack, and the production of the Christmas lamb requires considerable work during this slack season, thus giving a better distribution of labor on the farm. Not only are the highest prices for the lambs obtained at this season, but as they are sold earlier than at other times they return more pounds of gain per pound of food, and their cost is therefore at a minimum.

In the production of winter lambs certain peculiar conditions must be met, and careful attention given to the details, which make the difference between profit and loss. This puts the "hot-house lamb" business into the hands of the man who is careful and methodical about his work. The first requisite is that the lambs shall come at the proper season, in November or December. October lambs would most likely be all right here, though too early in the west. They must be marketed during the Christmas holidays, as they will be too heavy to sell as fancy lambs if held much later. The heaviest demand is from the first of January to the middle of March, so it is best to have the ewes yean in November or December. The period of gestation in sheep

ranges from 150 to 154 days, so they must be bred in June or July. Ewes of ordinary breeds will not accept the ram at that season, and the Dorsets and their grades are the only ones that can be depended upon to produce lambs in November or December. Dorset-Merino grades have been found very satisfactory, also the Dorset-Shropshire, though the latter is not as certain to breed at the proper season. Good grade ewes are preferable as mothers for raising such lambs, as they are cheaper and are often stronger and more vigorous mothers. The rams should be pure bred, as grade sires are not prepotent, consequently failing to sire lambs of uniform merit. Bearing in mind that lambs of good size, possessing first-class quality, with high grade of flesh and good feeders, are the object, some breed possessing these characteristics should furnish the ram. For the largest lambs and good quality of flesh Hampshire rams are very good. In this State, as the Shropshire is the most popular and rams of the breed easily obtainable, it would seem best to select good, vigorous and good-sized Shropshire sires.

The ewes should be sheared early and kept on light food from March until the latter part of May, aiming at only medium condition. Pasture them in May, to keep them gaining until bred. When pasture is not good they should receive grain in addition. Rams should be in similar condition. The preferable plan is to keep the ram with the ewes at night only, but it is usually more convenient to turn them with the flock, letting them remain all the time, until every ewe has been bred. After they have all taken the ram he should be removed from the same pasture.

The barn or shed in which the ewes and lambs are to be cared for should be wind proof, reasonably warm, and considerable glass on the south side is an advantage. The best of ventilation should be arranged. It is advisable to provide separate quarters for the lambs, separated from the ewes by a "creep." Only sufficient bedding to keep the sheep clean is necessary, an excess being objectionable. Gypsum will keep down the ammonia from the fermenting manure. Supply salt and water in the barn, so that the ewes and lambs need not go out doors from the time they are put in until the young animals are slaughtered and sold.

Feeding should be about the same as for ordinary lambs, except that more protein must be furnished the winter lamb, and he should be forced, if possible, to eat more grain all the time. Carrots and Swede turnips are very valuable for the ewes and a few may be given the lambs, although bright, fresh silage, which has never been frozen, is as well for palatability and more economical. The guide as to the amount of feed both for ewes and young is their general thrift. Keep enough food before the ewes at all times to insure a full flow of milk, as it is from this source that the quickest and steadiest gain for the lambs must come. Corn meal and wheat bran in the proportion of three of meal to one of bran is a very excellent mixture for the lambs, and if

fed with good clover hay will produce surprising growth. If silage or chopped roots are available they should be fed once a day, with bran and meal sprinkled over it. Feeding three times a day all the grain that will be cleaned up is recommended. Troughs for both mother and offspring should be cleaned thoroughly at each feed. Silage taken from the bottom of the silo is likely to prove harmful, because of the acid in this part.

With proper care in feeding, weights of from 45 to 60 pounds in from eight to ten weeks should be the rule, and the lambs should be very fat. They should be in such condition from the start that they will be ready to sell at any time. They should now be slaughtered and "hog dressed," to prepare them for the market. This is more or less of a fancy operation, requiring care and skill, since a well-dressed carcass will far outsell one that is poorly finished. In this connection no better advice can be given than that by Dr. H. P. Miller of Ohio, who has had considerable experience with the winter lamb. He says: —

The preparation for market requires some skill, yet only such as almost any one can develop after carefully studying directions. Methods of preparation have been greatly simplified, and the lambs seem apparently to continue to sell as well as before.

It is important to have them thoroughly bled out. To secure this it has been found of advantage to suspend the lamb from the hind feet in killing. Suspend a short singletree about six feet from the ground. Loop a small rope or strong twine about each hind leg and attach to the hooks of the singletree. With a sharp-pointed knife sever the artery and vein in the neck, close to the head. Be sure to sever the artery. Bright red blood is the assurance. The venous blood is dark. Severing the head with a broad axe would perhaps cause less suffering and insure thorough bleeding. The head is removed with a knife as soon as the lamb stops bleeding. Clip the wool from the brisket and a strip four or five inches wide upward to the udder or scrotum, also from between the hind legs, as in tagging sheep. Slit the skin up the inside of the hind quarters about four inches, and loosen the skin from the underlying muscles for about two inches on either side of the openings in the skin for the attachment of the caul fat. This should be removed from the stomachs before they are detached, and in very cold weather placed in warm water until ready to use. Next remove the stomach and intestines. In the early part of the season the liver, heart and lungs are not removed, but when the weather gets warm they must be. Carefully spread the caul fat over all the exposed flesh. Good toothpicks should be provided for attaching it and holding it in place. Make small slits in it over the kidneys and pull them through. In this part of the work is where skill is required to make the carcass attractive. Now hang it in a cool place for twelve to twenty-four hours. In extremely cold weather twelve hours is long enough, but it is better to make twenty-four the rule. Then neatly sew a square yard of clean muslin about each lamb, so as to cover up all exposed surface. It was formerly customary to wrap each one in burlap and attach it to a stretcher, but now three lambs are placed in a light crate, with burlap tacked over the top. The crate is lined with heavy paper. Prepare them as shortly before shipping as possible. In warm weather ice may be put *between* the lambs, not *in* them. Send them as they are ready, three or six at a time. The market varies greatly, depending upon the weather and the number arriving. It is not possible to get them all on a high market. Aim to slaughter regularly each week, keeping your customers advised as to when, and how many you will be likely to ship.

With the special opportunities that are apparent in a large part of the State why not grow a home product of widely known quality for home use? The demand of Boston, Hartford and New York — selecting these cities at random — could be partially supplied by home-grown sheep, for which a fancy price would be paid if the consumer were assured of the value and high quality of the product. Mutton is the sweetest and most tender of meat, lacking the grossness and coarse texture of beef, and possessing a cleaner and more wholesome flavor than pork. It will suit the daintiest palate and satisfy the heartiest appetite. Who has ever partaken of a nicely turned leg o'mutton, tastily garnished and attractively served, whose mouth doesn't water for another such feast? Massachusetts could and should take up sheep growing as a much larger part of her activity than it is at present.

RENOVATING OLD ORCHARDS.

BY PROF. F. C. SEARS, PROFESSOR OF POMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

There are undoubtedly thousands of old apple trees in Massachusetts, some in orchards and others scattered about fields, which would pay good returns if they could be thoroughly "renovated" and thereafter be given proper treatment. On the other hand, there are just as many, and probably far more, which would be more profitable on the woodpile than anywhere else. The first question, then, for one to decide, if he owns such trees or orchards, is "Will it pay to make the attempt to get them into a thrifty condition again?" In the writer's opinion this depends on four questions: 1, the age and vigor of the trees; 2, the stand of trees in the orchard; 3, the varieties; and 4, whether the San José scale is in the orchard or the immediate vicinity of it. To discuss each of these briefly:—

1. *The Age and Vigor of the Trees.*—If the trees are vigorous, with good trunks and main branches, unaffected with canker or other injuries to the bark, it has been my experience that they can be brought into a profitable condition even though the tops are full of dead branches and they have been systematically neglected for years. This, of course, is supposing that the other factors mentioned above are favorable. It is truly surprising what can be done with an old orchard when it is taken in hand and given modern, up-to-date treatment. On the other hand, if the trunks or main branches are damaged with canker, or have been injured with cold so that the bark has fallen away in patches of any size, as very often happens, then it is very doubtful if the orchard would pay for renovating. It must be remembered that the trunk is the highway by which the results of our improved care are transported back and forth from the roots to the top, and if this highway is in a demoralized condition we are not going to get the best results.

2. *The Stand of Trees.* — This, of course, is supposing that the trees to be treated are in an orchard, and it will be easily seen that if half of the trees are out it is not going to pay to cultivate and fertilize the whole of the land for trees which could be put on half of it. And it is never satisfactory to attempt to grow anything else in such vacant

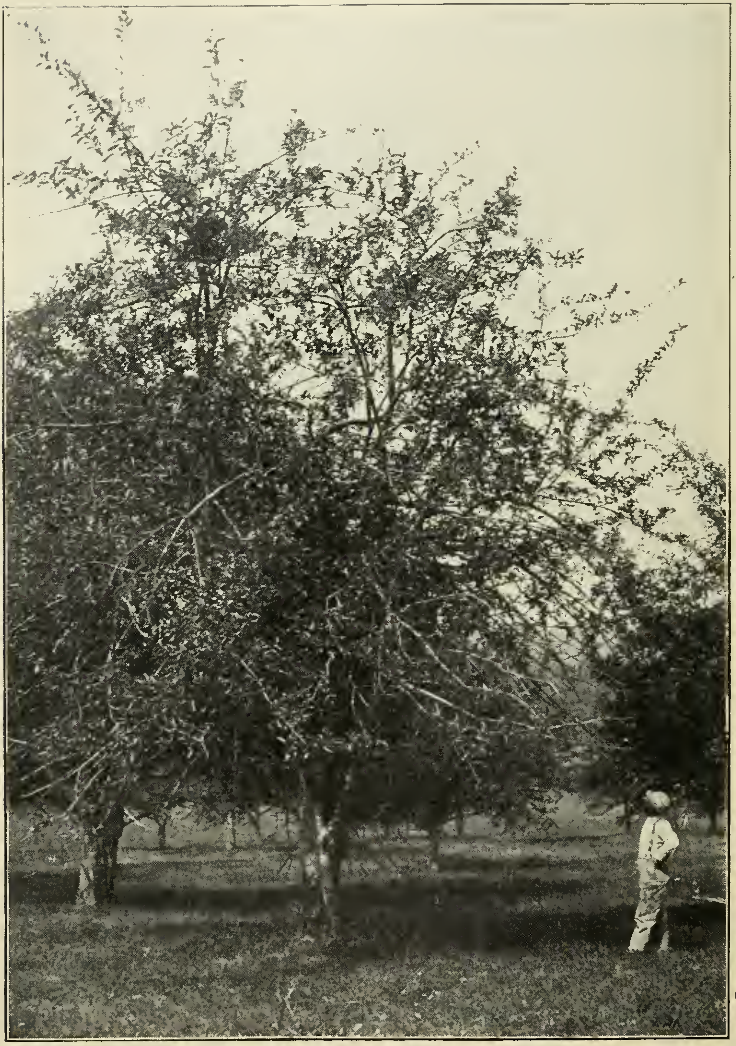

Fig. 1. — Type of tree which should be cut back severely in renovating; 10 or 12 feet at least could be removed to advantage. Except for poor trunk (see Fig. 2) this tree could be very successfully remodelled.

spaces in an old orchard, nor to plant young trees in the vacancies. If the trees are along fences or odd corners, so that cultivation of the soil will not be attempted, then the question of stand is less important, and may, perhaps, be ignored altogether. But in an orchard there ought to be a three-quarters stand at least to make it worth while to take the matter up, except under the most favorable circumstances.

3. *The Varieties in the Orchard.* — This is of less importance than the two points already mentioned, yet it is a factor that is decidedly worth considering and that has an important bearing on the cost of the renovating process. It is, of course, possible to graft over the trees, but this is both an expensive and a lengthy operation, and I should condemn an orchard to the brush heap which needed to be grafted far more quickly than one which already had the right varieties in it. Of course the question of varieties is very largely a personal one, and need not be discussed here, but I should mean by "right" such varieties as suited the grower and the markets for which he was producing, preferably standard sorts, like Baldwin, Rhode Island Greening and Roxbury Russet.

4. *The San José Scale.* — I should certainly feel much less like attempting to recover an old orchard which was infested with the scale, or even which was near an infested orchard, than one which was free from it and in a locality where it did not exist. I do not mean by this that I should despair of recovering an orchard where the scale was fairly plentiful, for I have known of a number of cases where such orchards have been made thrifty and profitable. But it certainly does add a very serious element to the situation, and it is going to require both time and money to eradicate it.

The above, as I have said, are the main factors in deciding for or against the renovation of an old orchard, yet perhaps I have omitted the chief factor after all, and that is the man himself. If he has just come into possession of the orchard, and is making an attempt to clean up all along the line, I should have far more faith in the ultimate good results of the matter than if he were author and finisher of the neglect from which the orchard has suffered, even though he might have firmly determined to "do the right thing by the orchard" from henceforth.

Having finally decided that the orchard is worth while, the work of renovating will fall naturally under the following heads: 1, cultivation; 2, pruning; 3, spraying; 4, fertilizing; 5, cover-crops; 6, grafting, — arranged somewhat in the order of their importance, though of course this will vary greatly with different orchards, and though all will be needed to secure the best results.

I have placed cultivation first because, though trees will often do well in sod, if otherwise well cared for, and though it may sometimes be necessary, even in attempting to revive an old orchard, to let the trees stand in sod, yet, as a rule, to get them into satisfactory condition cultivation is the prime requisite, and will do more than any other one thing to start the orchard on the right road. It is usually difficult

in an old orchard, such as we are considering, to do anything like a thorough job of plowing. If one can secure an ox team they will do the work better than a team of horses, as they will be able to get under the trees better, and the slow, steady gait of the oxen is better than that of most horses. Do not be alarmed over cutting some tree roots with the plow, even some large roots. A little root pruning will not hurt the trees, and the fresh, new, feeding-roots, sent out from the broken and cut ends of the old roots, will very soon equal in absorbing ability the parts of the old roots which are cut away. Another point in plowing is the question of throwing the furrow towards or away from the trees. One frequently finds an old orchard in which the plowing has been for years always in the direction of the trees, until each row stands along a ridge, with deep hollows between. Such an orchard should be plowed away from the trees, until the land gets back reasonably level again. After that it is well to plow the orchard alternately towards and away from the trees, — one year north and south and the next east and west. In this way the land can be kept in the best condition for the trees.

Occasionally it is impossible to do even a makeshift job of plowing, and then one can sometimes begin operations by running a heavy disc harrow through the orchard, to cut up the sod and start things in the right direction, and perhaps plow it the following year.

After the plowing has been done it is always advisable to use the disc harrow and follow it with the spring-tooth harrow, going both ways with each one of them, and going over the land several times, so as to get the land in good tilth. After this, through the balance of the season, it is best to cultivate the land once every week or ten days, up to perhaps the middle of July. And let this weekly cultivation be thorough! If the two harrows suggested, disc and spring-tooth, are available, it is well to run the disc over first, the long way of the orchard, and then finish with the spring-tooth, the opposite way. This insures all the land being worked over, and leaves it more level than if one finishes with the disc, which of course is desirable on account of reducing evaporation. It is difficult to overdo cultivation at this season of the year, and with an old, neglected orchard I should feel inclined to let this be the principal feature of the programme, so far as the soil is concerned.

Now for our second point in the programme, pruning. This is apt to vary more in the extent to which it is needed and in the character of it which is best to apply than any one of the other factors. If the trees are very high, with little or no bearing wood near the center, as is very apt to be the case, then they should be given very drastic pruning, so as to grow an entirely new top, a good many feet nearer the ground than the old one. It will practically amount to the removal of all the top in perhaps two years, and the branches should be cut down at least six or eight feet, and sometimes much more. This seems like heroic treatment and it is, but in the great majority of cases, if

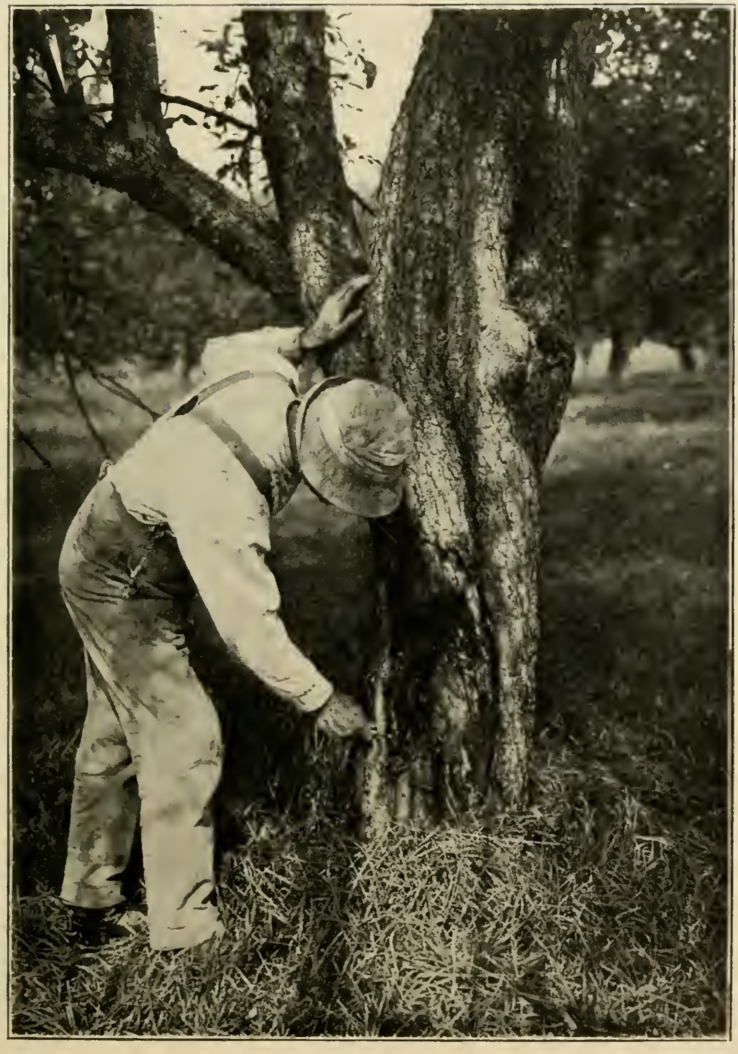

Fig. 2. — Trunk injured by cold. Such trees are not worth renovating.

the trees are otherwise healthy, they will send out a bushy top, which, with judicious thinning, will make practically a new tree out of the old one. And one great reason why such old trees as we are now considering (tall, overgrown ones) are *not* profitable is that they are so tall that every operation — pruning, spraying, picking, etc. — is four or five times as costly as with lower trees. So it is absolutely essential to get them down nearer the ground if they are ever to be made profitable. On the other hand, if the trees are reasonably low the pruning may consist largely in thinning the top throughout, beginning, of course, with the dead branches, and then taking enough live ones to leave the head fairly open to light and air, and to the sprayer when that comes on the scene. Even in this class of trees (those which are *not* unreasonably tall), it is often possible to reduce their height to advantage, without materially altering their form, by simply cutting back each of the main, upright branches to one of its strong, main offshoots. The effect may not be just what we would like at the start, and the top may be somewhat thrown out of balance, but with a year's growth it will largely recover its symmetry, and even if it should not altogether the advantages of the lower top will offset any disadvantages.

Another point in this pruning, and one often neglected, is not to remove too large branches in the thinning. Of course it is much easier to remove what one considers the required amount of wood by taking out a few large branches, but the results are much better if one will take comparatively small branches (not above an inch and a half in diameter) and take more of them. This thins the top uniformly, letting in light, air and spraying materials to all parts equally; while the removal of a few large branches leaves the top too open in some places and as thick as ever in others. Still another point which one should bear in mind in his pruning is to keep a sharp watch for diseased branches, and take these out in preference to healthy ones. The European and blight cankers are, in particular, liable to be found in such an orchard, and may be largely held in check by such pruning. And lastly, after the pruning has been done, and the wounds made have had time to dry up and "check" somewhat, all wounds of an inch and a half or over should be thoroughly painted with thick lead paint, to keep out moisture and prevent decay. White lead and boiled linseed oil make the best kind of covering for such wounds, but it is well to add a little brown color, merely to take off the glaring whiteness of the painted wounds. One frequently sees the advice to take a paint pot into the tree when pruning, and attend to the painting at once, when the limb is removed, but in the writer's experience the pruning tools are all that one wants to be bothered with at one time, and the paint will certainly adhere better to the cut surface when this has dried somewhat.

Our thirdly is the spraying problem. This is going to vary somewhat, according to the insect and fungous diseases which may be

present in the orchard or locality. If the San José scale is there a thorough spraying with the lime-sulphur wash, just before the buds swell in the spring, will be found to be the most efficacious treatment. Some of the other ways of fighting this pest come highly recommended, particularly the soluble oils, but in the writer's observation the best thing at present is the lime-sulphur, and one has the satisfaction of knowing that while he is driving this pest out of his plantation he is also most effectively reducing the vigor of a number of fungous diseases, which might have caused trouble later in the season. In this connection (fighting insects and fungi) one is frequently asked as to the desirability of scraping the trees to remove the rough, scaly bark. While this ought not to be necessary as a regular practice in orchards which are cared for, and especially in those which are sprayed, yet in the beginning I believe it is an excellent treatment for such orchards as we are considering. Certainly it will add materially to the effectiveness of any washes which may be applied to the trunks of the trees.

Next to the lime-sulphur wash, Bordeaux mixture stands out pre-eminently as the spraying material. And if the San José scale is not in the orchard it will probably be the only material necessary to use if we add to it, as of course we will, some arsenical poison, preferably arsenate of lead, for chewing insects. It is a little difficult to outline just what the season's campaign should be in spraying, without knowing what foes we have to combat, but in general the following will be found satisfactory. Begin before the buds swell, at least to any extent, and make a thorough application of Bordeaux mixture. Use the Bordeaux type of nozzle, which throws a coarse stream with more force than other types. Spray trunk and main branches, as well as the top, and with these parts particularly, trunk and large branches, do not be afraid to use plenty of material. This is contrary to the rules of good spraying when the trees are in leaf, but when they are bare the advantage of reaching thoroughly all the cracks and crevices in the bark will offset any disadvantages. Let this spraying be followed by another, just before the blossom buds open, when they are large enough to be separated from each other in the cluster and to show some pink or white, but before they have opened enough to show the stamens or pistils. For this spraying I should use the same materials, Bordeaux mixture and arsenate of lead, but I should use an entirely different nozzle, selecting one of the Vermorel or the Friend type, which, instead of throwing a coarse stream with some force, delivers the spray in fog-like mist, which will float about among the leaves and buds, and thus reach all parts of them. I should be much more careful about drenching the trees. Spray so as to wet them thoroughly with as little drip as possible, and again spray trunk and main branches as well as the other parts. If this spraying is followed by a third one within a week or ten days after the petals have fallen from the blossoms, using the same materials and the same nozzle, and the same precautions, as in the second spraying, I should have a great deal of confidence

Fig. 3. — A promising type of tree for renovating. When dead branches have been removed and top thinned it will make an excellent tree.

that the result would be a crop of clean fruit. Of course one may be confronted by special problems, like an acute attack of canker worms or a scourge of apple aphis, in which case a specialist should be consulted. But for all ordinary cases the foregoing programme ought to be entirely adequate, and it would certainly surprise most old orchards to receive half of this attention.

The fourth factor in our operations is the fertilizer question, which is naturally very closely related to our cultivation problems and sometimes has to be varied to suit the cultural methods adopted. At the beginning I do not believe it is desirable to apply any nitrogenous fertilizers, or if they are applied it should be in very limited quantities, and early in the season. A moment's reflection will show the philosophy of this. Trees which have been allowed to grow in sod, as the old orchards which we are considering will undoubtedly have been, and in soil which has been impoverished by constant removal of the grass as hay, and of the fruit, without any return of fertilizer, will have long, straggling roots sent out to forage at a distance for all the plant food possible. And these long roots will have comparatively few branches or small feeding roots, as it is notorious that roots branch freely in a fertile soil and sparsely in a poor soil. Now when the land in the orchard is plowed and cultivated, and fertilizers are applied, the conditions become very much more favorable in the soil, and the roots begin to branch freely in response to these improved conditions. If the fertilizer has been applied in the form of barn manure, as is often the case, this requires some time to decay and get into soluble condition so that the roots can take it up, but when this has taken place it furnishes a large amount of highly nitrogenous food which tends to stimulate a very strong wood growth late in the season. The trees having the root systems such as we have described, long and spreading, and having sent out an abundance of feeding roots all along these original main roots in response to improved conditions, are sure to take up an unusual amount of this plant food, much more than trees which have had regular care from the beginning, and which therefore have more compact root systems. The result is that the growth is continued very late in the season, that the new layer of tissue between the old bark and wood does not ripen up in the autumn as it should, and that when cold weather comes on it is no better fitted to withstand freezing than a potato or a cabbage, and is destroyed during the winter. Soon after this the bark separates from the wood, and the tree dies if the bark has been killed all round, or is seriously weakened if only part way. For these reasons, as I said in the beginning, I should advise withholding nitrogenous fertilizers almost entirely the first season. If the soil has any fertility to it at all the cultivation and consequent improved physical condition will liberate all the nitrogen that the trees need to make an entirely satisfactory growth.

But of course these arguments do not apply to other fertilizers, and

I should use them freely. I should begin with a half ton per acre of lime. It has been my observation that very few old orchards indeed will not respond wonderfully to such an application. We need not discuss the usual methods of determining whether lime is needed, but I am satisfied that even when such tests as litmus paper, for example, fail to indicate a sourness in the soil, an application of a half ton of lime per acre will still be very beneficial to the trees. With apples particularly, but with all fruits more or less, an abundance of lime gives a shorter, stockier growth of wood, and fruit which, though perhaps a little smaller, is more firm, better keeping and more highly colored. This lime application need not be made every year, of course, but I should begin with it and should repeat it once in four or five years.

In addition to this I should give a yearly application of potash and phosphoric acid. For the former, experiments at the Massachusetts Agricultural College seem to indicate that the low-grade sulphate is the best form. If this is used 400 or 500 pounds ought to be applied per acre per year, and it is better applied as early in the season as possible and plowed under. I should favor plowing under all fertilizers, as it gets them down where the feeding roots are, and where they will be under such conditions as to make them most quickly available. Of course this is less important with the readily soluble fertilizers, but even with these I should favor turning them under. The other two forms of potash used are the high-grade sulphate and the muriate, both of which are used very largely in orchards, and both of which are 50 per cent actual potash, and consequently one gets the required amount of potash with the least amount of material, and so with the least expense. Application of either should be 200 to 300 pounds per acre yearly.

In phosphoric acid one has the choice of several different forms, but probably the best two for the orchardist are Thomas phosphate or basic slag, and one of the superphosphates or acid phosphates. Where one is plowing the land I should favor the use of the basic slag, as, in addition to the phosphoric acid, it contains a large percentage of lime, which will assist in putting the soil in good shape. It will run usually about 15 per cent to 17 per cent of phosphoric acid, and from experience in many orchards it seems to be an admirable form. On the other hand, where one is not able to plow the land, or for any reason has decided not to, the superphosphate is the best form of phosphoric acid, as it is readily soluble, and will therefore get down to the roots of the trees more quickly and more certainly than the basic slag. As to quantities per acre or per tree, a good yearly application of the slag would be from 300 to 400 pounds per acre, or on scattering trees from 8 to 10 pounds per tree. Where the superphosphates are used the quantity applied would vary with the source of the material from which they were manufactured, but probably should be from one-third to one-half less than of the basic slag. These quantities are

Fig. 4. — A poor type of tree for renovating. Trunk is too long and main branches have no bearing wood except at tops. If renovation is attempted this tree should be severely cut back to renew the top.

merely suggested as the usual ones applied, and it should be borne in mind that there is little danger in applying an over-dose of either potash or phosphoric acid, as neither one leaches out of the soil to any extent, nor does either one, when present in moderate excess in the soil, produce the injurious effect on the orchard that an over-supply of nitrogen does. They should be applied as early in the spring as possible, and worked into the soil as much as is possible with the method of culture adopted.

We come now to the question of cover-crops for the orchard, by which is meant some crop grown in the orchard, usually late in the season, and exclusively, or at least mainly, with the object of improving the soil of the orchard. That it can be made to play a very important part in the upbuilding of an old orchard has been shown time and again. Some of the best ones for Massachusetts orchards are buckwheat, rye, soy beans, cow peas and the vetches. The chief advantages derived from their use would be that they take plant food away from the trees in the autumn and thus help to ripen them up; that they catch and hold nitrates in the soil after the growth of the trees has stopped, and when these substances would otherwise be washed out of the soil; that they help to pulverize and rot down the sod, which is especially important at the beginning; that when they are plowed under they furnish humus, which in turn furnishes plant food to the trees; and that in the case of soy beans, cow peas and the vetches they help to keep up the store of nitrogen in the soil by what they take up from the air and store in their roots. This is by no means all that these cover-crops do, but it covers the main points, and serves to show how important they are. The general plan of their use would be this: that the orchard would be plowed as early in the spring as the soil would permit and thoroughly fitted as outlined earlier. Then thorough cultivation would continue up to the middle of July, when the cover-crop would be sown. The only important deviation from this course would be in the case of some of the leguminous cover-crops mentioned, particularly soy beans and cow peas, which often give better results if sown in drills earlier in the season, the last of June or the first of July, and cultivated several times before the orchard is laid by. Of course, the objection to this is that the cultivation by this method is much more costly, since it must be done with a one-horse cultivator, a row at a time, instead of with a disc or spring-tooth harrow, covering three or four times the space. But even this objection is often, if not usually, overbalanced by the much better growth of the cover-crop.

After cultivation ceases and the cover-crop is sown nothing further is done to the soil until the following spring, when the cover-crop is plowed under, and the programme begins again. Where a good growth of one of the nitrogenous cover-crops can be secured it is often possible to obtain all the nitrogen needed for the orchard in this way.

I should feel inclined to begin with buckwheat as a cover-crop in

starting an old orchard because it is peculiarly effective in rotting down sod and putting the soil in fine physical condition. This might be followed in a year or two with either soy beans, summer vetch or cow peas.

As to amounts of seed per acre of the different crops suggested the following will be found right for ordinary conditions: —

Buckwheat,	1 bushel.
Rye,	$1\frac{1}{2}$ bushels.
Soy beans,	2 bushels broadcast; $1\frac{1}{2}$ bushels in drills.
Cow peas,	2 bushels broadcast; $1\frac{1}{2}$ bushels in drills.
Summer vetch,	$1\frac{1}{2}$ bushels broadcast; 1 bushel in drills.
Winter vetch,	1 bushel broadcast; $\frac{3}{4}$ bushel in drills.

And lastly there is the question of top-grafting the trees. I have already said that I should consider the necessity of this a strong factor against the orchard, for it requires considerable time, two to four years, and not a little expense, to work over the trees into other varieties. But it frequently happens that odd trees in an orchard are of unsatisfactory varieties, and it is sometimes worth while to graft over an entire orchard where the trees are relatively young and otherwise in good condition. Where this is to be done I believe it is generally advisable to employ an expert grafter or grafters to do the work. There is often a local artist who will undertake the operation, or, if the orchard is of sufficient size to warrant it, a professional grafter can be secured from a distance. In either case it is better business, and more satisfactory generally, to pay by the stub, and to have the grafter guarantee the scions to live. Of course in such a case one must have confidence enough in the man to insure that he will not put in grafts needlessly, but after all it is better to have too many grafts than not enough, and with a little knowledge and supervision on the part of the owner there is usually little difficulty on this score. If the owner is situated so that he can do so I should strongly advise his furnishing the scions himself, and too great care cannot be exercised in selecting them. They ought to be taken from bearing trees, and if possible from those of known productiveness, and they should be thoroughly well matured and not too long jointed. Let them be selected while the trees are still dormant, and stored in moist soil or sawdust in the coolest possible place; if an ice house is available so much the better.

A great many problems will undoubtedly come up in renovating an old orchard besides those which have been discussed, and modifications will have to be made to suit special fruits, such as peaches and plums, but if a campaign along the general lines indicated could be made among the old, and at present profitless, orchards of the State, either cleaning them up or cutting them down, it would certainly do a great deal toward putting Massachusetts fruit on a better footing with both dealers and consumers, and it would make an addition to the income of the farmers of the State by no means to be despised.

STRAWBERRY CULTURE.

BY PROF. F. A. WAUGH, HEAD OF THE DIVISION OF HORTICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

Henry Ward Beecher is generally credited with the saying that doubtless God might have made a better fruit than the strawberry, but doubtless God never did. This curious remark would never have kept in circulation so long had it not met with popular approval. In reality this seems to express the settled judgment of a large section of the American people. The strawberry is indeed one of our most popular fruits. It is abundantly used by every one, from the honest laborer to the malefactor of great wealth.

Probably statistics would show that the consumption of strawberries per capita is larger in Massachusetts than in any other State in the Union. This State has an unusually large population of well-paid laborers, artisans, clerks and other good, homely, honest people, generally comprised under the term "the great middle class." These are precisely the people who are the best customers for all classes of fruits. They constitute the great strawberry market.

With such a market at our very doors, it is strange that strawberry growing has not developed into a larger industry in Massachusetts. As a matter of fact, many carloads of berries are shipped here every year. These shipments are not confined to the early spring months, before the local crop is ready, but they continue throughout the season, when Massachusetts berries are being harvested. All through our own berry season car-lot shipments are coming forward from the Hudson River section and from Oswego, N. Y. This indicates clearly that our own growers have not yet occupied the home market.

The reason for this is not altogether clear. If there were a large margin of profit in the growing of strawberries doubtless it would not take long to develop sufficiently extensive plantations within the State to supply the home demand. It is certainly true that a good many growers have not found the strawberry business profitable. Nevertheless, on the face of the returns, it would seem that farmers, fruit growers and market gardeners favorably located with respect to soil and shipping facilities would find a paying opportunity in the growing of strawberries.

There is another side of the question also to be considered, namely,

the growing of berries for home use. More than almost any other fruit, the strawberry suffers by being shipped and roughly handled in markets. The fresh berries out of one's own garden, thoroughly-ripened on the vines, picked in the cool of the morning, and eaten at noon with plenty of Jersey cream, — these are what make life worth living and a national inquiry into the status of the farmers' appetite unnecessary. It certainly is a fact that more attention should be given in Massachusetts to the growing of strawberries for home use.

Soils and Localities.

Strawberries can be successfully grown in every town in Massachusetts, so far as climate and locality are concerned, — that is, wherever a reasonably good soil is available. The strawberry plant is not extremely fastidious in the matter of soil. Any land which will produce good garden crops, especially good potatoes, will answer for strawberries. A rich, friable, warm loam is best; but even heavy clay or sandy soil will grow strawberries if sufficient care is taken.

The soil should be in a reasonably good state of cultivation before the plants are set out. It is considered bad practice to plant on newly broken sod land. If strawberries can follow corn, celery, tomatoes or other well-cultivated garden crops good results may be expected. If the plants are to be put out in spring, as is the usual practice, the land should be deeply plowed in fall and left to weather through the winter.

How to get the Plants.

Doubtless the simplest way to get strawberry plants is to buy them of a good nurseryman. This is a perfectly safe proposition and nothing need be said against it. At the same time, many persons prefer to grow their own plants, and where this practice can be followed it is certainly to be recommended. In our experience, we have found a certain danger in buying plants, even from the very best of nurserymen. In the first place, it is not always possible to get the varieties wanted nor to get the plants when wanted; and, what is more serious, plants frequently suffer more or less damage in shipment. Even when packed in the very best manner they dry out more or less; or, if they do not dry out, they may mold or heat. These difficulties may be entirely avoided by growing one's own plants.

The importance of beginning with strong, vigorous, one-year-old plants cannot be too much emphasized. The weak, diseased plants, some minus roots, some minus crowns, and some two years old, sent out by bogus nurserymen, are not worth planting. A two-year-old plant which has once borne fruit is not fit to transplant; yet a considerable percentage of cheap plants offered every year on the market and taken from old fruiting beds are these two-year-old, worthless stock.

The simplest and surest way of getting plants is to take them from the sides of the fruiting rows. Each plant sends out runners during

FIG. 1. — A New Strawberry Field in a Clearing in the Woods.

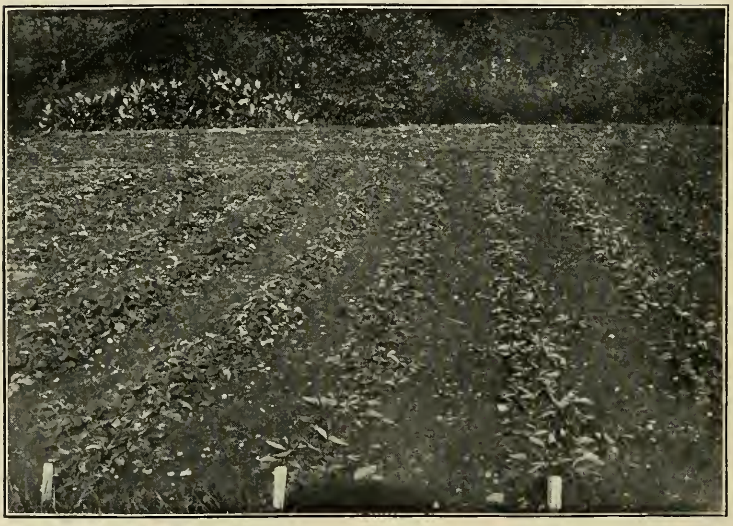

FIG. 2. — Strawberry Field grown by Hedgerow System.

the year which form new plants at each joint. If these new plants become established in deep, rich soil, they will make strong roots and crowns. The strawberry grower, thus carefully selecting along his own strawberry rows, can secure such plants as he desires. These plants may be taken out in spring just at the time of transplanting. We have found it rather better, however, to take them up during the fall and heel them in. Small beds are especially prepared for this purpose in deep, well-drained soil. These are covered with loose, dry mulch during the winter, and the plants are taken out in prime condition at transplanting time in the spring.

A word should be said also about the use of potted plants. These are largely advertised every fall and are very interesting to amateurs. Any one who has a few small flowerpots (2¼ or 2½ inches) at his disposal may grow these plants for himself. The pots are buried in the soil beside the fruiting rows in the latter part of June or the first of July. Each pot is filled with soil, and a young strawberry plant, still attached to the mother plant, is set into the buried pot. Plants so treated should form large, strong crowns by the last of August. They may then be severed from the mother plants and transplanted from the pots with very little shock. Such plants will bear a small crop the next year, — under favorable conditions, a moderately good crop. This method is advertised every autumn as a means of saving one year on the strawberry plantation. In reality, it is not a commercial method at all and not to be recommended for use on a large scale. Still, it is very interesting to the amateur and always worth his (or her) while.

Setting out Plants.

Spring setting of strawberry plants is the regular practice. On light, well-drained soils which do not heave fall setting may be practiced, it being always necessary to mulch the beds well in autumn. However, fall setting, aside from the use of potted plants, as described above, is not to be generally recommended. On the other hand, it is good practice to set the plants just as early as possible in the spring. In some localities and with some growers there is a prejudice in favor of late spring setting, but this does not apply to most parts of Massachusetts.

Where large areas are to be set with strawberry plants, a business-like organization of the work is essential. The ground should be thoroughly prepared, well harrowed and in prime condition. The rows should be carefully marked out where they are to go. Usually these will be 3 feet apart. Some growers prefer 3½ feet, but a larger number prefer less, — some 2 feet, some 2½ feet. The plants will be set at varying distances in these rows, depending upon the system of culture to be followed; about 16 inches apart is the distance usually prescribed. The plants should be set with a dibble. The man who does the setting takes this in his right hand while he takes up the plant with his left. The dibble is thrust into the loose soil at the point

where the plant is to stand, is pushed forward, and the plant is inserted with the left hand into the opening thus made. The dibble is then raised out of the ground and the soil firmed heavily about the roots with both hands. This firming is important. The man then moves forward on his knees to the position for the next plant.

It is highly important to observe in setting plants that they be not placed too deeply in the soil, nor yet too shallow. If they are placed so deeply that the crown is covered with soil, the plant will not grow. If they are placed so high that the crown is well above the soil, they will dry out and die. The correct position is to have the bud or crown exactly at the surface. Planters require constant watching on this point.

General Culture.

After planting, the strawberry beds require the best sort of tillage. This is a crop which can never be profitably neglected. The cultivator should be kept going between the rows, especially in dry weather. Such cultivations should follow one another every week or ten days, some soils, of course, requiring more tillage than others. On large plantations a double two-horse cultivator can be used to advantage; on ordinary plantations the single one-horse cultivator will usually be employed. The light frame with harrow teeth will be most useful in soil which is in proper condition.

Tillage should become less frequent towards fall and may cease altogether after September 10. Before heavy freezing occurs the beds should be mulched. At least, mulching is generally considered to be necessary and on the whole seems to be worth while, though we have seen excellent crops of berries grown on unmulched beds. Here again a great deal would depend on the character of the soil, drainage, exposure, etc.

It shouid be distinctly understood that rapid rotations are essential to the successful culture of the strawberry. The crude, old-fashioned plan of setting strawberry beds and leaving them to themselves for eight or ten years at a stretch is merely a waste of land. It is still unfortunately customary in many parts of New England to leave strawberry beds for three or four years, with the idea of taking two or three crops from one planting. The most successful growers, however, undertake to secure only one crop from any one plantation. The plants are grown one year, are fruited the next, and the beds are plowed up immediately after the berry harvest. This method not only gives the best fruit, but proves to be the most profitable.

Mulching.

It is customary to protect strawberry plants through the winter by covering them with mulch. This mulch is raked off the rows in spring, as soon as the snow is off, allowing the plants to grow freely. Some very conscientious growers rake the mulch entirely out of the

Fig. 3. — Mulching Strawberry Bed.

Fig. 4. — Strawberry Field at Picking Time.

field. This is done so as to permit the running of cultivators between the rows. Such spring tillage is unquestionably a good thing, though it is troublesome and expensive. Some men even go so far as to put back the mulch after cultivating the ground. Usually the mulch is left between the rows, as close to the plants as possible. It thus serves to protect the fruit from becoming soiled during rain storms. Without such protection the dirt spatters up onto the berries, and leaves them in very bad condition for market.

Various kinds of material are used for this mulching process. Anything which is clean, not too full of weed seeds, and will lie closely on the ground will answer the purpose. Marsh hay, poor straw and other bedding material may be used. Cornstalks make an excellent mulch, except that they are rather coarse. Shavings and sawdust are sometimes used, but are objectionable; they are apt to injure the soil. Buckwheat straw, pea straw and waste of that character are especially satisfactory.

This mulch should be put on late in the fall, after moderate freezing of the ground.

In good, well-drained soil in most towns in Massachusetts strawberries will often go through the winter in very good condition without mulching. Nevertheless, mulching is safer, and the mulch is needed during fruiting time, even though it may not be required for winter protection.

Methods of Management.

There are four general methods of managing strawberry beds for common use. These may be called (*a*) solid beds, (*b*) matted rows, (*c*) hedge-row system, (*d*) hill system.

The old-fashioned, lazy and shiftless method of growing strawberries is to keep them in solid beds. Plants are set out in rows at any ordinary distance, and runners are allowed to form *ad libitum.* Within a year or two the ground is entirely covered with strawberry plants. These take care of themselves as well as they can, and the grower accepts what fruit he gets as a gratuity. Such a bed on good soil will last for five or six years and give some fruit. The best method of treating such beds is to burn them over early every spring. This burning kills some fungous diseases and a good many insects. This method, of course, is not recommended.

The matted-row system is the one most commonly practiced. According to this method the plants are set in double rows. There will be two rows of plants about 8 inches or a foot apart, then a space of 3 feet for cultivation, then two more rows, then a space, etc. The plants will be set 14 to 18 inches apart in the rows, usually alternating in the adjoining rows. As these form runners, they are allowed to set new plants along the middle of the double row and for a small space on each side. The bed soon comes to consist of matted rows about 18 inches wide, with space for running a cultivator between. If good

fertilization is given, and good culture on good soil, such a bed will give very fair results. For ordinary market purposes it answers well.

The hedge-row system is an improvement on the matted-row system now considerably practiced by advanced growers. Any one who wishes to grow a specially fine grade of berries for home use, or for a fancy market, can well afford to adopt this improved plan. According to this system rows are placed about 2½ feet apart, with plants 14 inches apart in the row. A very limited number of new plants are allowed to set from the runners, these being kept quite closely in the line of the original row. Each plant, therefore, receives the benefit of much more thorough cultivation than it does in the matted-row system. It also has the benefit of a larger proportion of fertilizer, it has more space to develop, and it is otherwise more favorably situated. Larger fruit of somewhat better grade can be grown than by the matted-row method.

The hill system is used only by enthusiastic amateurs, or those who wish to grow fruit for exhibition purposes. In this case the plants are set in suitable rows, the individual plants being 18 inches or even 2 feet apart, and each plant is kept down to a single hill by cutting off all runners as fast as they form. Thus each plant can be given the very best of care, and has the benefit of all the surrounding soil and light.

Fertilizers.

Liberal feeding is desirable for strawberry beds. This liberality must begin as soon as the plants are set out, or even before, for the soil should be in first-class condition before planting. Professor Voorhees suggests 500 to 800 pounds of fertilizer, made up as follows: raw ground bone, 1 part; acid phosphate, 1 part; muriate of potash, 1 part, — to be applied before setting out the plants. Plants should then have an application of some quick-acting nitrogenous fertilizer, preferably nitrate of soda, as soon as they start to grow. This would mean 50 to 60 pounds of nitrate of soda, or 50 to 60 pounds sulphate of ammonia, or 100 pounds of dried blood. The necessary point is to give the plants a vigorous growth from the very first. The second spring, when a crop of fruit is expected, an additional dressing of nitrogenous fertilizer should be given. This would consist of 100 pounds of nitrate of soda or 150 pounds of dried blood per acre.

Prof. William P. Brooks, fertilizer expert of the Massachusetts Experiment Station, makes the following recommendations regarding the fertilization of strawberry plantations : —

	Pounds.
Tankage or Peruvian guano,	600
Fine ground bone,	1,000
Low-grade sulphate of potash,	600
Nitrate of soda,	100

All of these materials may be mixed, applied after plowing and before setting the plants, and thoroughly incorporated into the soil by harrowing.

	Pounds.
Dried blood,	200
Tankage or Peruvian guano,	800
Low-grade sulphate of potash,	600
Basic slag meal,	1,000
Nitrate of soda,	100

The slag in this selection of materials must not be mixed with the blood, tankage or guano, as it will cause a loss of ammonia. It will be better, therefore, to apply the slag by itself, but all the other materials may be mixed before application.

Diseases and Insects.

Strawberry plants are not subject to any very serious diseases. The leaf spot may be a partial exception to this statement, but on well-managed fields it is not usually serious. Thorough spraying with Bordeaux mixture is usually recommended for this disease, but good cultivation and liberal feeding will do a great deal more by way of prevention than can be done by any spray solutions.

Winterkilling of the plants, especially the roots, is sometimes reported from different parts of the State, but this can usually be prevented by proper mulching, as explained above.

The insects most commonly noticed in strawberry fields are the white grub, the crown borer and the leaf roller. The white grub is found the most commonly in raw land not in a good state of cultivation, or such as has been heavily treated with quantities of unrotted barnyard manure. Good soil and thorough cultivation are the best preventives.

The leaf roller is sometimes quite troublesome, and after it becomes thoroughly established in a plantation there is no practical remedy for it. If thoroughly sprayed with Paris green or other arsenical poisoning as soon as it appears, its work may be checked.

The crown borer may be largely circumvented by proper rotations. If new beds are placed beside old infested beds the crown borer is pretty sure to do serious damage. The obvious preventive, therefore, is to plant strawberries on fresh soil, away from old infested beds.

Varieties.

There are hundreds of varieties of strawberries on the market. Every nurseryman has his favorites, and every year sees a number of novelties exploited. An unusually large proportion of these varieties are meritorious. In fact, almost any variety will give good results if well cultivated. It would be impossible within the limits of this paper to give a long list of varieties with descriptions or notes; it may suffice to say that Glen Mary, Clyde, Dunlap, Bubach, Warfield and Marshall are the kinds most commonly and successfully grown in Massachusetts.

Marketing the Crop.

Most localities in Massachusetts have an additional advantage in strawberry growing in the fact that pickers can be easily secured for a moderate price. In all factory towns it is possible to get a number of energetic boys and girls for this work. The almost universal payment for picking is 2 cents a quart.

Berries are always picked early in the morning and placed in quart baskets. These baskets are sent to market in crates holding 24, 32, 36 or 48 quarts.

It is good practice, especially where a good grade of fruit is grown, to sort all the berries, facing up each quart box as apples are faced in barrels. This does not mean that small berries are to be put in the bottom of the box, but simply that the fruit is to be made to look as attractive as possible.

Usually berries shipped in crates to city markets, like Springfield, Worcester and Boston, bring reasonably good prices. When they do not, it is owing to some local difficulty, or to a temporary glut. The most satisfactory way to sell berries, of course, is in the home market, direct to one's own customers. There are so many localities in which this can be done that this sort of trade may be considered characteristic of Massachusetts. It is a line of business which will bear very much larger development.

FINANCIAL RETURNS

AND

Analysis of Premiums and Gratuities

OF THE

INCORPORATED SOCIETIES,

WITH

MEMBERSHIP AND INSTITUTES,

For the Year 1908.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held invested as Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural),	1881	$1,002 32	[1] $8,222 68	$8,121 97	$8,222 68
2	Barnstable County,	1844	1,740 00	[2] 9,910 00	9,910 00	10,232 21
3	Blackstone Valley,	1884	3,000 00	[3] 4,400 00	4,400 00	4,617 00
4	Deerfield Valley,	1871	4,094 01	[3] 9,200 00	9,450 00	9,450 00
5	Eastern Hampden,	1856	3,000 00	[4] 7,272 11	7,000 00	7,272 11
6	Essex,	1818	4,527 20	[5] 17,965 17	17,965 17	17,965 17
7	Franklin County,	1850	3,768 00	[6] 11,029 76	11,000 00	11,029 76
8	Hampshire,	1850	3,255 26	[7] 5,150 00	5,150 00	5,182 53
9	Hampshire, Franklin and Hampden,	1818	8,141 29	[8] 15,538 45	15,538 45	15,538 45
10	Highland,	1859	3,262 00	[1] 3,197 35	3,120 00	3,197 35
11	Hillside,	1883	3,113 32	[8] 6,151 17	6,151 17	6,152 67
12	Hingham (Agricultural and Horticultural),	1867	17,406 15	[8] 4,833 06	4,833 06	4,833 06
13	Hoosac Valley,	1860	2,006 00	[7] 16,500 00	16,500 00	16,938 53
14	Housatonic,	1848	6,335 33	[9] 25,910 47	25,910 47	25,910 47
15	Marshfield (Agricultural and Horticultural),	1867	3,755 33	[7] 13,000 00	13,000 00	13,330 12
16	Martha's Vineyard,	1859	4,552 17	[10] 4,774 61	4,774 61	4,852 04
17	Massachusetts Horticultural,	1829	525 00	[11] 564,524 70	816,982 06	828,948 17
18	Massachusetts Society for Promoting Agriculture,[12]	1792	–	–	–	–
19	Middlesex North,	1855	3,000 00	[13] 7,179 45	7,179 45	7,294 35
20	Middlesex South,	1854	3,000 00	[3] 12,000 00	12,200 00	12,562 57
21	Nantucket,	1856	3,500 00	[3] 3,200 00	3,200 00	3,206 10
22	Oxford,	1888	4,400 00	[8] 11,061 77	11,061 77	11,061 77
23	Plymouth County,	1819	9,550 00	[14] 1,726 31	1,726 31	1,726 31
24	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[7] 10,350 00	10,350 00	10,354 08
25	Union (Agricultural and Horticultural),	1867	4,447 23	[7] 9,000 00	9,000 00	9,063 33
26	Weymouth (Agricultural and Industrial),	1891	10,270 00	[7] 11,270 00	11,270 00	11,274 74
27	Worcester,	1818	7,730 00	[8] 88,401 53	88,401 53	88,401 53
28	Worcester East,	1890	2,296 23	[8] 10,476 52	10,476 52	10,476 52
29	Worcester Northwest (Agricultural and Mechanical),	1867	3,400 00	[8] 13,514 29	13,514 29	13,514 29
30	Worcester South,	1855	3,127 40	[7] 11,400 00	11,400 00	11,709 29
31	Worcester County West,	1851	3,175 00	[7] 14,000 00	14,000 00	14,236 78
			$150,413 24	$931,059 40	$1,183,586 83	$1,198,553 98

[1] Invested in real estate, cash, crockery, tables, etc.

[2] Invested in real estate and bank funds.

[3] Invested in real estate.

[4] Invested in real estate and cash.

[5] Invested in real estate, notes, cash, crockery, tables, etc.

[6] Invested in real estate, notes and cash.

[7] Invested in real estate, crockery, tables, etc.

Societies for the Year ending Dec. 31, 1908.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,716 69	–	–	–	$100 00	$405 28	–	$1,600 71	1
8,000 00	–	–	$1,910 00	–	–	$322 21	873 60	2
4,400 00	–	–	–	–	–	217 00	1,669 80	3
9,200 00	–	–	–	–	250 00	–	104 52	4
7,000 00	–	–	–	–	–	272 11	6,474 13	5
15,300 00	–	$1,920 00	–	–	200 00	545 17	8,500 00	6
10,000 00	–	1,000 00	–	–	–	29 76	3,740 00	7
5,000 00	–	–	32 53	–	150 00	–	2,296 68	8
14,512 15	–	–	326 30	–	700 00	–	3,000 00	9
3,000 00	–	–	–	–	120 00	77 35	–	10
5,000 00	–	–	801 17	–	350 00	1 50	–	11
2,500 00	–	–	1,243 15	–	1,000 00	89 91	–	12
16,000 00	–	–	–	–	500 00	438 53	9,000 00	13
24,849 37	–	500 00	101 23	–	425 00	34 87	2,050 00	14
12,500 00	–	–	–	–	500 00	330 12	1,649 04	15
2,750 00	$125 00	–	1,649 61	–	250 00	77 43	10 00	16
518,564 63	16,500 00	226,010 00	–	–	55,907 43	11,966 11	5,714 00	17
–	–	–	–	–	–	–	–	18
–	5,108 00	–	2,071 45	–	–	114 90	13 45	19
12,000 00	–	–	–	34 00	200 00	328 57	7,848 00	20
3,200 00	–	–	–	–	–	6 10	–	21
10,700 00	–	–	161 77	–	200 00	–	350 00	22
–	–	–	1,673 10	–	39 00	14 21	–	23
9,400 00	–	–	–	–	950 00	4 08	1,879 50	24
8,000 00	–	–	–	–	1,000 00	63 33	1,304 25	25
11,000 00	–	–	–	–	270 00	4 74	3,540 00	26
72,101 31	–	–	14,361 86	–	1,938 36	–	–	27
10,034 00	–	–	–	–	425 00	17 52	–	28
13,000 00	–	–	214 29	–	300 00	–	3,950 00	29
11,100 00	–	–	–	–	300 00	309 29	622 60	30
13,000 00	–	–	–	227 68	1,000 00	9 10	525 00	31
$839,828 15	$21,733 00	$229,430 00	$24,546 46	$362 39	$67,380 07	$15,273 91	$66,715 28	

[8] Invested in real estate, bank funds, crockery, tables, etc.

[9] Invested in real estate, stocks, bank funds, crockery, tables, etc.

[10] Invested in real estate, notes, bank funds, crockery, tables, etc.

[11] Invested in real estate, library, furniture, bonds and other securities.

[12] Represented on the Board by special enactment, and makes no returns.

[13] Invested in notes and bank funds.

[14] Invested in bank funds, cash, crockery, tables, etc.

FINANCIAL RETURNS OF THE INCORPORATED SOCIETIES

	SOCIETIES.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural),	–	$100 71	$1,500 00	$2,779 81	$600 00	–
2	Barnstable County,	$98 60	75 00	700 00	7,732 86	600 00	$60 00
3	Blackstone Valley,	–	14 80	1,655 00	5,235 80	600 00	–
4	Deerfield Valley,	–	104 52	–	2,969 69	600 00	–
5	Eastern Hampden,	–	324 13	6,150 00	7,424 86	600 00	–
6	Essex,	–	–	8,500 00	5,082 47	600 00	2 43
7	Franklin County,	–	40 00	3,700 00	8,010 28	600 00	–
8	Hampshire,	–	121 68	2,175 00	2,247 08	600 00	–
9	Hampshire, Franklin and Hampden,	–	200 00	2,800 00	8,895 40	600 00	–
10	Highland,	–	–	–	1,893 71	600 00	–
11	Hillside,	–	–	–	1,584 39	600 00	–
12	Hingham (Agricultural and Horticultural),	–	–	–	808 80	600 00	16 50
13	Hoosac Valley,	–	–	9,000 00	4,395 85	600 00	–
14	Housatonic,	–	50 00	2,000 00	11,684 58	600 00	28 87
15	Marshfield (Agricultural and Horticultural),	42 95	–	1,606 09	6,543 08	600 00	–
16	Martha's Vineyard,	–	10 00	–	1,652 48	600 00	56 88
17	Massachusetts Horticultural,	[1] 5,714 00	–	–	17,097 33	600 00	–
18	Massachusetts Society for Promoting Agriculture,[2]	–	–	–	–	–	–
19	Middlesex North,	13 45	–	–	875 63	600 00	275 63
20	Middlesex South,	–	–	7,848 00	3,397 73	600 00	–
21	Nantucket,	–	–	–	1,296 10	600 00	–
22	Oxford,	–	–	350 00	4,465 50	600 00	–
23	Plymouth County,	–	–	–	493 61	303 00	78 00
24	Spencer (Farmers' and Mechanics' Association),	–	79 50	1,800 00	2,735 46	600 00	–
25	Union (Agricultural and Horticultural),	4 25	–	1,300 00	2,410 51	600 00	–
26	Weymouth (Agricultural and Industrial),	–	40 00	3,500 00	5,368 06	569 80	6 01
27	Worcester,	–	–	–	26,359 06	600 00	1,059 63
28	Worcester East,	–	–	–	8,926 13	600 00	9 78
29	Worcester Northwest (Agricultural and Mechanical),	–	–	3,950 00	9,288 50	600 00	–
30	Worcester South,	89 60	133 00	400 00	6,407 44	600 00	–
31	Worcester County West,	–	–	525 00	5,667 99	600 00	–
		$5,962 85	$1,293 34	$59,459 09	$173,730 13	$17,671 80[3]	$1,593 73

[1] Awarded in 1908; paid in 1909.

[2] Represented on the Board by special enactment, and makes no returns.

[3] Bristol County Fair, Inc., received $600 on account of its 1907 fair, but held no fair in 1908 and made no returns.

FOR THE YEAR ENDING DEC. 31, 1908 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
–	$12 00	$35 25	$2,132 56	$2,083 75	$667 70	$1,329 90	$86 15	–	1
–	60 00	82 60	6,930 26	7,410 65	2,824 75	3,200 79	40 00	$1,345 11	2
–	47 00	2,842 50	1,746 30	5,018 50	852 65	798 28	65 00	3,302 57	3
–	10 00	25 52	2,334 17	2,969 69	1,482 30	938 76	–	548 63	4
–	29 00	–	6,795 86	7,152 75	772 50	2,856 73	263 12	3,260 40	5
–	48 00	12 00	4,420 04	4,632 34	963 00	2,862 57	261 67	445 10	6
$40 00	–	–	7,370 28	8,010 28	2,527 25	3,883 67	374 36	1,225 00	7
–	57 50	148 98	1,440 60	2,214 55	818 72	1,267 29	128 54	–	8
–	174 00	–	8,121 40	7,979 10	1,226 00	2,000 00	158 80	4,594 30	9
–	29 00	21 20	1,243 51	1,816 36	690 15	1,122 51	3 70	–	10
–	67 00	16 00	901 39	1,718 77	760 65	688 58	–	269 54	11
–	6 00	16 55	169 75	889 43	581 80	273 56	–	34 07	12
–	20 00	–	3,775 85	4,677 95	950 00	3,277 95	450 00	–	13
26 25	364 00	–	10,665 46	10,878 72	5,188 25	5,009 82	100 00	580 65	14
–	65 00	–	5,878 08	6,212 96	2,041 90	4,053 97	117 09	–	15
–	24 00	8 00	963 60	1,179 39	717 08	367 61	–	94 70	16
11,025 00	698 00	–	4,774 33	19,680 72	[3] 5,876 40	–	–	13,804 32	17
–	–	–	–	–	–	–	–	–	18
–	–	–	–	995 04	660 04	125 00	–	210 00	19
–	41 50	221 50	2,534 73	3,069 16	1,561 00	1,167 85	48 00	292 31	20
–	25 00	75 12	595 98	1,290 75	605 75	685 00	–	–	21
–	43 00	46 75	3,775 75	4,465 50	1,766 44	1,331 44	–	1,367 62	22
–	35 00	28 61	50 00	394 40	323 35	71 05	–	–	23
–	13 00	53 00	2,069 46	2,731 38	1,447 59	1,181 04	102 75	–	24
–	31 00	14 00	1,765 51	2,347 18	1,185 51	919 25	135 25	107 07	25
–	–	30 60	4,761 65	5,363 32	667 15	3,564 72	93 75	1,037 70	26
–	235 00	665 00	23,799 37	23,098 59	7,190 89	–	–	15,907 70	27
–	47 00	925 50	7,343 85	9,747 07	2,110 35	7,286 66	–	350 06	28
–	–	–	8,688 50	9,074 21	3,635 25	3,478 61	274 70	1,685 65	29
–	76 00	–	5,731 44	5,738 34	2,252 50	3,157 44	50 00	278 40	30
–	45 00	1,369 00	3,653 99	5,008 42	2,246 35	1,244 20	40 94	1,476 93	31
$11,091 25	$2,302 00	$6,637 68	$134,433 67	$167,849 27	$54,593 37	$58,144 25	$2,893 82	$52,217 83	

[3] Awarded in 1907.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural), ...	$1,600 71	$702 85	$667 60	–	–	–	[1] –
2	Barnstable County, . .	[2] 3,353 50	[2] 2,923 35	[2] 2,824 75	$128 00	–	–	$641 00
3	Blackstone Valley, . .	1,116 15	938 15	852 65	145 00	$67 00	$67 00	703 50
4	Deerfield Valley, . . .	1,814 95	1,482 30	1,482 30	–	–	–	849 00
5	Eastern Hampden, . .	1,106 00	820 10	772 50	98 00	10 00	10 00	771 00
6	Essex, ...	2,350 00	1,196 50	963 00	–	–	–	1,244 00
7	Franklin County, . . .	[2] 4,141 00	[2] 2,527 25	[2] 2,527 25	–	–	–	2,500 00
8	Hampshire, ...	1,212 25	818 72	818 72	–	–	–	854 00
9	Hampshire, Franklin and Hampden, ...	1,738 25	1,273 50	1,226 00	50 00	–	–	1,279 00
10	Highland, ...	771 90	690 15	690 15	–	–	–	473 50
11	Hillside, ...	925 00	772 95	760 65	2 50	2 50	2 50	637 00
12	Hingham (Agricultural and Horticultural), . . .	1,537 45	581 80	581 80	71 75	–	–	–
13	Hoosac Valley, . . .	1,200 00	950 00	950 00	–	–	–	700 00
14	Housatonic, ...	[2] 5,723 00	[2] 5,188 25	[2] 5,188 25	–	–	–	1,543 00
15	Marshfield (Agricultural and Horticultural), . .	[2] 2,457 90	[2] 2,084 85	[2] 2,041 90	126 00	–	–	446 00
16	Martha's Vineyard, . .	687 00	717 08	717 08	18 00	–	–	413 00
17	Massachusetts Horticultural,	6,700 00	5,876 40	[3] 5,876 40	500 50	200 50	[3] 200 50	–
18	Massachusetts Society for Promoting Agriculture,[4] .	–	–	–	–	–	–	–
19	Middlesex North, . . .	700 00	673 49	660 04	–	–	–	123 50
20	Middlesex South, . . .	1,800 00	1,629 05	1,561 00	75 00	18 00	15 00	788 00
21	Nantucket, ...	1,200 00	605 75	605 75	51 00	9 00	9 00	604 00
22	Oxford, ...	[2] 2,235 00	[2] 1,840 75	[2] 1,766 44	78 00	43 00	43 00	800 00
23	Plymouth County, . . .	296 85	323 35	323 35	40 00	63 00	63 00	66 50
24	Spencer (Farmers' and Mechanics' Association), .	1,900 00	1,500 10	1,447 59	65 00	45 00	45 00	1,015 00
25	Union (Agricultural and Horticultural), ...	1,690 45	1,189 86	1,185 61	–	–	–	821 50
26	Weymouth (Agricultural and Industrial), ...	1,105 00	667 15	667 15	–	–	–	679 00
27	Worcester, ...	[2] 8,719 50	[2] 7,190 89	[2] 7,190 89	–	–	–	4,003 00
28	Worcester East, . . .	3,038 60	2,128 30	2,110 35	32 00	28 00	28 00	2,050 80
29	Worcester Northwest (Agricultural and Mechanical), .	[2] 3,783 00	[2] 3,648 00	[2] 3,635 25	–	–	–	[1] –
30	Worcester South, . . .	[2] 2,637 00	[2] 2,252 50	[2] 2,252 50	132 00	31 00	31 00	1,080 50
31	Worcester County West, .	[2] 2,768 84	[2] 2,255 50	[2] 2,246 35	57 00	24 00	20 00	1,066 34
		$70,309 30	$55,448 89	$54,593 37	$1,669 75	$541 00	$534 00	$25,152 14

[1] Not reported. [2] Including trotting.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1908.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$271 50	$271 50	–	–	–	[1] –	$255 55	$255 55	[1] –	$3 50	1
504 25	475 00	$141 00	–	–	$452 30	342 05	322 90	$11 00	5 00	2
680 50	640 50	–	–	–	115 40	83 15	62 15	10 00	3 00	3
606 00	583 88	–	–	–	77 00	74 60	73 20	12 00	10 00	4
547 50	547 50	–	–	–	141 25	145 70	145 70	32 00	20 00	5
487 25	278 50	196 00	–	–	500 00	382 25	352 00	14 00	–	6
1,128 75	1,128 75	–	–	–	500 00	258 10	258 10	21 00	17 00	7
455 35	435 55	–	–	–	196 00	156 00	156 00	11 50	2 00	8
991 50	956 25	101 00	–		204 25	169 50	168 50	36 00	8 00	9
428 95	428 95	27 50	$20 75	$20 75	64 75	63 40	63 40	5 00	5 00	10
523 00	521 00	45 00	40 25	40 25	97 00	83 75	79 70	4 00	2 00	11
–	–	166 00	39 00	39 00	951 95	382 20	382 20	3 50	2 00	12
560 50	560 50	–	–	–	120 00	71 50	71 50	10 00	4 00	13
1,151 00	1,151 00	214 00	213 00	213 00	312 00	302 50	302 50	34 00	30 00	14
305 40	289 90	77 50	–	–	212 00	178 95	167 50	12 00	6 00	15
284 95	284 95	–	–	–	103 50	142 40	142 40	10 00	4 00	16
–	–	–	–	–	6,843 50	5,917 00	[3] 5,917 00	–	–	17
–	–	–	–	–	–	–	–	–	–	18
170 00	166 50	–	–	–	269 90	211 80	204 55	–	–	19
401 25	362 25	77 00	20 00	20 00	228 00	116 80	110 85	–	–	20
268 75	268 75	131 00	40 00	40 00	163 00	40 00	40 00	16 00	–	21
668 00	626 86	65 50	52 50	50 62	139 50	84 00	82 63	9 00	6 00	22
78 00	78 00	–	–	–	93 85	85 75	86 35	–	–	23
710 00	690 00	50 00	12 50	12 50	90 00	70 00	70 00	60 00	60 00	24
492 13	489 16	–	–	–	74 95	55 79	54 51	13 25	7 25	25
347 80	347 80	46 00	7 00	7 00	210 00	128 60	128 60	5 50	3 25	26
2,643 50	2,643 50	–	–	–	579 50	470 00	470 00	30 00	17 00	27
1,428 00	1,423 75	–	–	–	353 75	322 00	319 25	21 00	8 00	28
925 50	915 25	–	–	–	[1] –	259 75	258 25	30 00	20 00	29
891 15	891 15	–	–	–	165 70	152 25	152 25	18 00	18 00	30
754 50	754 50	–	–	–	161 75	102 00	101 00	15 00	6 00	31
$18,704 98	$18,211 20	$1,340 50	$445 00	$443 12	$13,411 80	$11,107 34	$10,998 59	$443 75	$267 60	

[3] Awarded in 1907; paid in 1908.

[4] Held no fair and made no returns.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	$3 50	[1] –	$115 80	$115 80	$56 50	$56 50
2	Barnstable County, ...	5 00	$292 60	302 60	253 05	69 45	68 85
3	Blackstone Valley, ...	3 00	107 25	50 50	47 00	35 00	33 00
4	Deerfield Valley, ...	8 00	103 45	93 70	93 70	38 00	38 00
5	Eastern Hampden, ...	20 00	63 75	68 35	68 35	31 50	31 50
6	Essex, ...	–	254 00	175 25	166 00	125 00	120 25
7	Franklin County, ...	17 00	200 00	75 15	75 15	27 25	27 25
8	Hampshire, ...	2 00	54 00	49 25	49 25	42 75	42 75
9	Hampshire, Franklin and Hampden, ...	8 00	68 00	55 25	51 50	49 25	41 75
10	Highland, ...	5 00	65 25	74 25	74 25	22 80	22 80
11	Hillside, ...	2 00	119 00	104 25	100 20	21 00	21 00
12	Hingham (Agricultural and Horticultural), ...	2 00	152 25	101 60	101 60	57 00	57 00
13	Hoosac Valley, ...	4 00	210 00	142 50	142 50	125 00	125 00
14	Housatonic, ...	30 00	520 00	412 00	412 00	50 00	50 00
15	Marshfield (Agricultural and Horticultural), ...	6 00	142 00	124 00	121 00	46 00	46 00
16	Martha's Vineyard, ...	4 00	91 00	113 86	111 83	136 45	173 90
17	Massachusetts Horticultural, .	–	–	–	–	–	–
18	Massachusetts Society for Promoting Agriculture,[4] . . .	–	–	–	–	–	–
19	Middlesex North, ...	–	42 40	40 50	40 50	231 19	231 19
20	Middlesex South, ...	–	100 00	47 90	43 65	87 50	87 50
21	Nantucket, ...	–	60 00	87 25	87 25	86 75	86 75
22	Oxford, ...	6 00	82 50	73 82	73 82	8 00	8 00
23	Plymouth County, ...	–	28 50	28 00	28 00	68 00	68 00
24	Spencer (Farmers' and Mechanics' Association), ...	60 00	50 00	26 25	26 25	58 25	58 25
25	Union (Agricultural and Horticultural), ...	7 25	132 75	103 75	103 75	138 94	138 94
26	Weymouth (Agricultural and Industrial), ...	3 25	165 15	138 80	138 80	45 35	45 35
27	Worcester, ...	17 00	107 00	64 00	64 00	50 00	50 00
28	Worcester East, ...	8 00	496 05	287 30	276 10	80 00	55 00
29	Worcester Northwest (Agricultural and Mechanical), . .	20 00	[1] –	74 25	74 25	9 50	9 50
30	Worcester South, ...	18 00	101 75	97 90	97 90	65 50	57 00
31	Worcester County West, . .	6 00	110 75	108 25	104 35	8 00	8 00
		$265 00	$3,919 40	$3,236 28	$3,141 80	$1,869 93	$1,859 03

[1] Not reported. [2] And gratuities. [3] Estimated.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1908 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institute Sessions held.	Average Number attending Institutes.	
–	[2] 335	–	17	$70 70	201	39	240	8	54	1
$1,700 00	200	199	13	–	219	195	414	3	75	2
–	92	18	10	–	288	298	586	5	86	3
660 00	[2] 275	–	26	20 00	933	258	1,191	6	112	4
1,800 00	137	–	26	51 00	251	184	435	4	61	5
–	357	–	25	–	946	23	969	8	137	6
990 00	[1] –	[1] –	[3] 20	–	[3] 1,400	[3] 100	[3] 1,500	3	125	7
385 00	111	2	15	–	[1] –	[1] –	[3] 600	4	163	8
610 00	263	9	32	–	636	255	891	5	105	9
75 00	158	7	21	–	251	119	370	5	73	10
50 00	300	3	[3] 18	–	763	44	807	7	42	11
–	60	146	6	–	370	161	531	3	42	12
1,640 00	154	–	14	53 00	510	5	515	3	55	13
3,050 00	460	–	[1] –	–	1,669	85	1,754	3	183	14
1,397 50	78	221	24	75	308	527	835	6	83	15
89 00	[1] –	[1] –	6	–	83	86	169	3	42	16
–	152	65	87	175 00	710	116	826	10	81	17
–	–	–	–	–	–	–	–	–	–	18
–	130	32	8	–	1,112	445	1,557	9	336	19
400 00	116	20	15	–	306	184	490	2	45	20
65 00	127	43	1	–	208	383	591	3	24	21
950 00	48	4	14	3 00	349	281	630	3	102	22
–	[2] 125	–	[3] 10	–	[5] 610	[5] 512	[5] 1,122	7	38	23
705 00	144	7	22	–	473	412	885	3	250	24
402 00	157	68	19	9 00	655	839	1,494	4	221	25
945 00	488	14	14	–	488	14	502	3	100	26
3,950 00	323	6	59	936 50	1,449	211	1,660	7	108	27
1,139 48	304	46	39	217 00	475	299	774	5	178	28
2,220 00	270	–	31	24 25	[5] 648	[5] 308	[5] 956	6	96	29
1,000 00	116	67	25	47 00	770	758	1,528	5	59	30
1,350 00	185	112	40	23 75	421	81	502	5	61	31
$25,572 98	5,695	1,089	657	$1,620 95	17,502	7,222	25,324	148	[6] 109	

[4] Held no fair and made no returns. [5] Reported in 1907. [6] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS OF MASSACHUSETTS.

JUNE, 1909.

State Board of Agriculture, 1909.

Members ex Officio.

His Excellency EBEN S. DRAPER.
His Honor LOUIS A. FROTHINGHAM.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, M.A., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
F. WM. RANE, B. Agr. M.S., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
WARREN C. JEWETT of Worcester,	1910
CHARLES E. WARD of Buckland,	1911
HENRY M. HOWARD of West Newton,	1912

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1912
Barnstable County,	JOHN BURSLEY of West Barnstable,	1910
Blackstone Valley,	JACOB A. WILLIAMS of Northbridge,	1912
Deerfield Valley,	WM. B. AVERY of East Charlemont,	1911
Eastern Hampden,	O. E. BRADWAY of Monson,	1912
Essex,	FREDERICK A. RUSSELL of Methuen,	1911
Franklin County,	FRANK GERRETT of Greenfield,	1910
Hampshire,	HENRY E. PAIGE of Amherst,	1910
Hampshire, Franklin and Hampden,	FRANK P. NEWKIRK of Easthampton,	1912
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1911
Hillside,	W. A. HARLOW of Cummington,	1911
Hingham (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1912
Hoosac Valley,	L. J. NORTHUP of Cheshire,	1912
Housatonic,	N. B. TURNER of Great Barrington (P. O. Housatonic),	1912
Marshfield (Agr'l and Hort'l),	WALTER H. FAUNCE of Kingston,	1912
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1910
Massachusetts Horticultural,	WILFRID WHEELER of Concord,	1912
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1912
Middlesex North,	GEO. W. TRULL of Tewksbury,	1911
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1911
Nantucket,	JOHN S. APPLETON of Nantucket,	1912
Oxford,	WALTER A. LOVETT of Oxford,	1910
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1911
Spencer (Far's and Mech's Assoc'n),	W. J. HEFFERNAN of Spencer,	1910
Union (Agr'l and Hort'l),	GEORGE O. MILLARD of Blandford,	1910
Weymouth (Agr'l and Ind'l),	THERON L. TIRRELL of South Weymouth,	1912
Worcester,	B. W. POTTER of Worcester,	1911
Worcester East,	GEO. F. MORSE of South Lancaster,	1912
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1910
Worcester South,	C. D. RICHARDSON of West Brookfield,	1910
Worcester County West,	JOHN L. SMITH of Barre,	1911

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . .	HIS EXCELLENCY EBEN S. DRAPER, *ex officio*.
1st Vice-President,	AUGUSTUS PRATT of North Middleborough.
2d Vice-President,.	JOHN BURSLEY of West Barnstable.
Secretary, . .	J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. JOHN BURSLEY of West Barnstable.
AUGUSTUS PRATT of North Middleborough.
C. D. RICHARDSON of West Brookfield.
HENRY E. PAIGE of Amherst.
O. E. BRADWAY of Monson.
HENRY S. PEASE of Middlefield.
JOHN J. MASON of Amesbury.
CHARLES E. WARD of Buckland.

Committee on Agricultural Societies.

Messrs. O. E. BRADWAY of Monson.
ALBERT ELLSWORTH of Athol.
T. L. TIRRELL of South Weymouth.
WM. B. AVERY of Charlemont.
J. A. WILLIAMS of Northbridge.

Committee on Domestic Animals and Sanitation.

Messrs. HENRY E. PAIGE of Amherst.
WALTER A. LOVETT of Oxford.
F. A. RUSSELL of Methuen.
W. A. HARLOW of Cummington.
L. J. NORTHUP of Cheshire.

Committee on Gypsy Moth, Insects and Birds.

Messrs. AUGUSTUS PRATT of North Middleborough.
F. A. RUSSELL of Methuen.
B. W. POTTER of Worcester.
GEO. W. TRULL of Tewksbury.
W. J. HEFFERNAN of Spencer.

Committee on Dairy Bureau and Agricultural Products.

Messrs. C. D. RICHARDSON of West Brookfield.
W. C. JEWETT of Worcester.
HENRY E. PAIGE of Amherst.
GEORGE O. MILLARD of Blandford.
WALTER H. FAUNCE of Kingston.

Committee on Massachusetts Agricultural College.

Messrs. JOHN BURSLEY of West Barnstable.
W. C. JEWETT of Worcester.
ISAAC DAMON of Wayland.
FRANK GERRETT of Greenfield.
N. B. TURNER of Great Barrington.

Committee on Experiments and Station Work.

Messrs. HENRY S. PEASE of Middlefield.
N. I. BOWDITCH of Framingham.
T. L. TIRRELL of South Weymouth.
J. L. SMITH of Barre.
WILFRID WHEELER of Concord.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. J. J. Mason of Amesbury.
F. Wm. Rane of Boston.
John S. Appleton of Nantucket.
Frank P. Newkirk of Easthampton.
H. A. Turner of Norwell.

Committee on Institutes and Public Meetings.

Messrs. Chas. E. Ward of Buckland.
Kenyon L. Butterfield of Amherst.
J. F. Adams of West Tisbury.
H. M. Howard of West Newton.
Geo. F. Morse of Lancaster.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. C. D. Richardson of West Brookfield, 1911; Henry E. Paige of Amherst, 1909; W. C. Jewett of Worcester, 1910.

Executive Officer, ... J. L. Ellsworth.
General Agent, ... P. M. Harwood of Barre.

Office, Room 136, State House.

STATE NURSERY INSPECTOR.

Henry T. Fernald, Ph.D., of Amherst.

STATE ORNITHOLOGIST.

Edward Howe Forbush of Wareham.

SPECIALISTS.

By Election of the Board.

Chemist,	Dr. C. A. Goessmann,	Amherst.
Entomologist,	Prof. C. H. Fernald,	Amherst.
Botanist,	Dr. Geo. E. Stone,	Amherst.
Pomologist,	Prof. F. C. Sears,	Amherst.
Veterinarian,	Prof. James B. Paige,	Amherst.
Engineer,	Wm. Wheeler,	Concord.

By Appointment of the Secretary.

Librarian, F. H. Fowler, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

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[1] Deceased June 26, 1909; successor not appointed at time of going to press.

Agricultural Societies incorporated by Special Act of the Legislature, and represented on the Board of Agriculture.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,[1] . .	A. W. Bartlett, Salisbury.	M. H. Sands, Amesbury.	John J. Mason, Amesbury.
Barnstable County, ...	Dr. Gorham Bacon, Yarmouth.	M. N. Harris, Barnstable.	Henry C. Davis, Cummaquid.
Blackstone Valley, ...	W. A. L. Bazeley, Boston.	Dr. M. R. Sharpe, Uxbridge.	Chas. A. Barton, Uxbridge.
Deerfield Valley, ...	D. T. Barnard, Shelburne.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden, ...	O. E. Bradway, Monson.	L. E. Chandler, Palmer.	R. E. Cummings, Palmer.
Essex, ...	Fred'k A. Russell, Methuen.	J. M. Danforth, Lynnfield.	W. S. Nichols, Salem.
Franklin County, ...	Chas. P. Aldrich, Greenfield.	J. H. Murphy, Greenfield.	Frank H. Snow, Greenfield.
Hampshire, ...	H. A. Parsons, Amherst.	U. G. Groff, Amherst.	U. G. Groff, Amherst.
Hampshire, Franklin and Hampden.	Rufus M. Smith, Hadley.	C. A. Montgomery, Northampton.	C. A. Montgomery, Northampton.
Highland, ...	W. J. Chipman, Middlefield.	J. T. Bryan, Middlefield.	Geo. S. Bell, Middlefield.
Hillside, ...	H. S. Packard, Plainfield.	C. F. Burr, Ringville.	Robert L. Streeter, Cummington.
Hingham,[1]	Geo. E. Kimball, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley, ...	Dr. F. D. Stafford, North Adams.	Gilbert Maxwell, North Adams.	M. R. Ford, North Adams.
Housatonic, ...	C. H. Hale, Great Barrington.	Fred J. Fuller, Great Barrington.	Geo. L. Taylor, Great Barrington.
Marshfield,[1]	Thomas W. Lawson, Boston.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard, ...	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural, .	Gen. S. M. Weld, Dedham.	Wm. P. Rich, Boston.	Walter Hunnewell, Wellesley.
Massachusetts Society for Promoting Agriculture.	C. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex North, ...	Arthur H. Cluer, Lowell.	Andrew Liddell, Lowell.	John A. Weinbeck, Lowell.
Middlesex South, ...	John J. Erwin, Wayland.	Geo. C. Blades, South Framingham.	George E. Fay, Framingham.
Nantucket, ...	Thomas G. Dacy, Nantucket.	J. F. Murphy, Nantucket.	Asa C. Jones, Nantucket.
Oxford, ...	Byron Clark, Oxford.	J. E. Darling, Oxford.	J. E. Darling, Oxford.
Plymouth County, ...	Augustus Pratt, North Middleborough.	J. Herbert Leonard, Bridgewater.	J. Herbert Leonard, Bridgewater.

[1] And horticultural.

Agricultural Societies, etc. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Spencer Farmers' and Mechanics' Association.	Jonas C. Bemis, Charlton.	Geo. H. Ramer, Spencer.	Geo. H. Ramer, Spencer.
Union,[1]	H. K. Herrick, Blandford.	E. W. Boise, Blandford.	Geo. O. Millard, Blandford.
Weymouth (Ag'l and Ind'l), .	Josiah B. Reed, South Weymouth.	A. F. Barnes, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester, ...	Walter D. Ross, Worcester.	E. S. Knowles, Worcester.	L. F. Herrick, Worcester.
Worcester East, ...	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical).	F. G. Amsden, Athol.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South, ...	W. E. Patrick, Warren.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West, . .	John L. Smith, Barre.	D. H. Rice, Barre.	E. F. Williams, Barre.

[1] And horticultural.

Horticultural Societies.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Haverhill, ...	Haverhill, ...	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County, ...	Springfield, . . .	Adolph Mielliz, Springfield.	William F. Gale, Springfield.
Houghton, ...	Lynn, ...	Frank L. Whipple, Lynn.	Miss Helen L. Newhall, Lynn.
Lenox, ...	Lenox, ...	Allan Jenkins, Lenox.	Geo. H. Instone, Lenox.
Massachusetts, ...	The State, ...	Stephen M. Weld, Boston.	Wm. P. Rich, Boston.
North Shore, ...	Manchester, . . .	Wm. Till, Magnolia.	James Salter, Manchester.
Springfield Amateur, ...	Springfield, . . .	A. J. Griffin, Springfield.	J. Alden Davis, Springfield.
Worcester County, ...	Worcester, . . .	Geo. C. Rice, Worcester.	Adin A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Legrand F. Brigham, Bolton.	William M. Brigham, Bolton.
Needham,	Needham,	Geo. N. Smith, Wellesley Hills.	Geo. D. Adams, Wellesley.
Oakham,	Oakham,	W. M. Robinson, Oakham.	Rev. W. E. Streeter, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	Arno E. Hurd, Westminster.	Arthur W. Nye, Westminster.

Farmers' and Mechanics' Clubs.

Ashburnham,	Ashburnham,	E. J. Forristall, South Ashburnham.	W. E. Jefts, Ashburnham.
Belchertown,	Belchertown,	Harry H. Ward, Belchertown.	Almon L. Pratt, Belchertown.
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	E. W. Merrick, Jefferson.	M. Addie Holden, Holden.
Pepperell,	Pepperell,	H. W. Hutchinson, Pepperell.	Chas. F. Spaulding, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boxborough,	Boxborough,	R. Y. Nelson, Boxborough.	G. W. Burroughs, Boxborough.
Buckland,	Buckland,	F. L. Warfield, Buckland.	Mrs. C. E. Maynard, Buckland.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	W. E. Bartlett, Easthampton.	Wm. A. Underwood, Easthampton.
Franklin,	Franklin,	Walter Daniels, Franklin.	Fred M. Thayer, Franklin.
Halifax,	Halifax,	Jas. T. Thomas, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	D. Clarence Wetherell, New Braintree.	Chas. S. Lane, New Braintree.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Wm. H. Gladding, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
South Bristol,	New Bedford,	Herbert Wing, South Dartmouth.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	Herbert R. Kinney, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Appleton P. Williams, Upton.	Edward B. Newton, Upton.
West Brookfield,	West Brookfield,	S. Newell Cutler, Warren.	Sumner H. Reed, West Brookfield.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D. 2, Ludlow.

Poultry Associations.

Athol Poultry and Pet Stock Association,	Athol,	- -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	Daniel P. Foster, North Beverly.	Walter R. Bell, Manchester.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Greenfield Score Card Poultry Club,	Greenfield,	H. M. Woodward, Greenfield.	F. L. Gaines, Greenfield.
Lawrence Poultry and Pet Stock Association.	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Milford Poultry Association,	Milford,	Arthur Webb, Milford.	W. H. Pyne, Milford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northern Berkshire Poultry Association,	North Adams,	W. G. Carter, North Adams.	C. M. Ottman, North Adams.
Plymouth Poultry Association,	Plymouth,	T. Allen Bagnell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association.	Springfield,	E. C. Powell, Longmeadow.	E. S. Evans, Springfield.
West Brookfield Poultry Association,	West Brookfield,	R. H. Buffington, West Brookfield.	E. L. Richardson, West Brookfield.
Worcester Poultry Association,	Worcester,	Walter D. Ross, Worcester.	W. H. Fitton, Worcester.

Miscellaneous.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Agricultural Society of Harvard University,	Cambridge, . . .	Geo. L. Wilson, Cambridge.	Harold Styles, Cambridge.
Bay State Agricultural Society, . . .	The State, ...	C. Minot Weld, Boston.	N. I. Bowditch, Framingham.
Boston Market Gardeners' Association, .	Boston and vicinity, .	J. B. Shurtleff, Jr., Revere.	J. P. Estey, Newton Centre.
Brockton Agricultural Society, . . .	Brockton, ...	Charles Howard, Brockton.	Baalis Sanford, Brockton.
Connecticut Valley Breeders' Association, .	Western New England, .	George E. Taylor, Jr., Shelburne.	O. C. Burt, Easthampton.
Cranberry Growers' Association, . . .	Cape Cod District, . .	George R. Briggs, Bournedale.	Wm. M. Marsh, Boston.
Franklin Harvest Club, ...	Connecticut Valley, .	George E. Taylor, Shelburne.	C. B. Lyman, Southampton.
Hampden Agricultural Society, . . .	Springfield, . . .	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club, ...	Connecticut Valley, .	The members alternately.	Edwin C. Powell, Longmeadow.
Haverhill Agricultural Society, . . .	Haverhill, ...	Edward H. George, Groveland.	Leslie K. Morse, Haverhill.
Massachusetts Cattle Owners' Association, .	The State, ...	B. W. Potter, Worcester.	J. L. Harrington, Lunenburg.
Massachusetts Creamery Association, . .	The State, ...	W. H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association, . .	The State, ...	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Boston.
Massachusetts Fruit Growers' Association, .	The State, ...	John W. Clark, North Hadley.	S. T. Maynard, Northborough.
Massachusetts Society of Bee-keepers, . .	The State, ...	E. C. Britton, Canton.	S. J. C. Needham, Roxbury.
Massachusetts State Poultry Association, .	The State, ...	Henry D. Smith, Rockland.	J. H. Robinson, Boston.
Stockbridge Club, ...	Amherst, ...	H. W. French, Amherst.	J. C. Bailey, Amherst.
Ware Agricultural Society, ...	Ware, ...	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Worcester County Harvest Club, . . .	Worcester, . . .	Henry W. Carter, Millbury.	Mrs. D. A. Howe, Worcester.
Worcester County Bee-keepers' Association,	Worcester, . . .	Jas. P. Porter, Worcester.	Arthur W. Kallom, Worcester.
Worcester North Agricultural Society, . .	Fitchburg, . . .	H. O. Mead, Lunenburg.	W. H. Laws, Ashburnham.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1908.

Master,	Carlton D. Richardson of West Brookfield.
Overseer,	John E. Gifford of Sutton.
Lecturer,	Charles M. Gardner of Westfield.
Steward,	C. C. Colby of Hubbardston.
Assistant Steward,	C. O. Littlefield of Norwood.
Chaplain,	Rev. A. H. Wheelock of Marlborough.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	Wm. P. Greenwood of Milford.
Ceres,	Mrs. Ida Coleman of Richmond.
Pomona,	Mrs. Nellie S. Stevens of Wellesley.
Flora,	Mrs. Philomene Cook of Methuen.
Lady Assistant Steward,	Mrs. S. Mabel Thompson of Hopkinton.

Executive Committee.

George S. Ladd,	Southbridge.
C. A. Dennen,	Pepperell.
W. C. Jewett,	Worcester.

General Deputies.

Henry A. Barton,	Dalton.
N. B. Douglas,	Sherborn.
Elmer D. Howe,	Marlborough.
W. C. Jewett,	Worcester.
G. S. Ladd,	Sturbridge.
M. A. Morse,	Belchertown.
Herbert Sabin,	Amherst.

Pomona Deputies.

A. C. Stoddard,	North Brookfield.
William E. Patrick,	Warren.
Mrs. S. Ella Southland,	Athol.

Subordinate Deputies.

C. H. Shaylor,	Lee.
T. E. Flarity,	Townsend.
E. E. Chapman,	Ludlow.
F. L. Warfield,	Buckland.
E. F. Richardson,	Millis.
John Bursley,	West Barnstable.
L. R. Smith,	Hadley.
Moses U. Gaskill,	Mendon.
C. R. Damon,	Williamsburg.
E. B. Hale,	Bernardston.
H. N. Jenks,	Cheshire.
G. C. Sevey,	Springfield.
Elbridge Noyes,	Newbury.

Subordinate Deputies — *Con.*

Geo. E. Crosby,	Tewksbury.
E. H. Gilbert,	Stoughton.
Harry C. Shepard,	Sturbridge.
Frank N. Boutelle,	North Leominster.
E. W. Burtt,	Andover.
George W. Sherman,	Brimfield.
W. H. Sawyer,	Winchendon.
L. H. Cudworth,	Oxford.
W. A. Harlow,	Cummington.

Special Deputies.

John E. Gifford,	Sutton.
W. N. Howard,	South Easton.
J. P. Ranger,	North Brookfield.
W. T. Herrick,	Westborough.

Committee on Women's Work.

Mrs. H. E. Cummings,	North Brookfield.
Mrs. D. P. Bardwell,	Bardwell's Ferry.
Mrs. W. A. Monson,	Huntington.
Mrs. Fred Reed,	Shrewsbury.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	Nathan D. Fales, Norfolk.	John F. Mills, Needham.	J. Herbert Baker, Medfield.
Essex, No. 2,	Edward W. Boutwell, Lowell, R. F. D., No. 1.	Frederic O. Wheeler, Salem Depot, N. H.	Miss Matilda B. Lund, Ward Hill, R. F. D., No. 1.
Middlesex-Worcester, No. 3,	Mrs. Clara C. Flarity, Townsend.	Mrs. L. E. Starr, Pepperell.	Mrs. Minnie L. F. Knight, Townsend Harbor.
Franklin and Worcester, No. 4,	R. O. White, North Orange.	W. L. Wheeler, Templeton.	Mrs. Ellen M. Conant, North Orange.
Worcester West, No. 5,	H. A. Seaver, Templeton.	Mrs. J. S. Hillman, Hardwick.	Mrs. R. S. Titterton, Templeton.
Berkshire County, No. 6,	C. A. Daniels, Adams.	James E. Barden, Dalton.	J. C. Jenks, Adams, R. F. D.
Worcester Central, No. 7,	Ernest D. Howe, Millbury.	Mrs. Kate M. Thom, Uxbridge.	Mrs. Adelle E. Grout, Millbury.
Hampshire County, No. 8,	William Phillips, Hadley.	M. A. Morse, Belchertown.	John W. Marsh, Hadley.
Worcester Southwest, No. 9,	Harry C. Shepard, Globe Village.	Mrs. Phila P. Holmes, Southbridge, R. F. D.	Mrs. Mary Q. Ainsworth, E. Brookfield, R. F. D.
Worcester and Norfolk, No. 10,	Leonard E. Taft, Mendon.	Wm. P. Greenwood, Milford.	Annie E. Gaskill, S. Milford.
Borough, No. 11,	Herbert L. Wheeler, Berlin.	Mrs. S. Mabel Thompson, Westborough, R. F. D., No. 2.	Mrs. Maria A. Gilmore, Westborough, R. F. D., No. 2.
Springfield, No. 12,	Frank M. Graves, Granby.	Mrs. K. Adella Wood, E. Longmeadow.	Mrs. Carrie L. Hayward, Agawam.
Old Colony, No. 13,	Joseph W. Baldwin, North Easton.	Ernest H. Gilbert, N. Easton, R. F. D.	Mrs. Alida N. Stevens, 75 Tremont St., South Braintree.
Worcester East, No. 14,	J. Samuel Burpee, Pratt's Junction, R. F. D.	Mrs. Laura E. W. Farnsworth, Lancaster.	Mrs. Ida A. Cunningham, Lancaster.
Quaboag, No. 15,	John W. Williams, Warren.	Chas. D. Sage, N. Brookfield.	Mrs. Carrie E. Webb, W. Brookfield.
Middlesex North, No. 16,	Clarence H. Cutler, Lexington, Box 198.	Mrs. Francena L. Sherburne, Tyngsborough.	Mrs. Lulu M. Hutchins, Billerica.
Deerfield Valley, No. 17,	Wayne D. Wood, Zoar.	Mrs. D. P. Bardwell, Bardwell's Ferry.	Mary C. Burrington, Heath.
Western Hampden, No. 18,	W. T. Moore, Huntington.	C. M. Gardner, Westfield.	Annette Sackett, Westfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Connecticut Valley, No. 19,	H. B. Barton, Riverside, Gill.	Mrs. Nellie Hale, Bernardston.	Mrs. H. B. Barton, Riverside, Gill.
Hillside, No. 20,	Edward J. Clark, Worthington.	H. L. Merritt, Chesterfield.	Mrs. J. A. Miner, Cummington.
Swift River Valley, No. 21,	Charles E. Felton, Enfield.	Mrs. E. O. Marshall, New Salem.	Mrs. Geneva Sieg Ballard, Box 53, Millington.
Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	Fred A. Cowan, Greenfield.	Mrs. Nettie A. Fay, Greenfield.	Mrs. Grace M. Hinckley, Greenfield.
Deerfield, No. 2,	Lewis J. Smith, Deerfield.	Miss Kathryn Slocomb, Deerfield.	P. G. Davis, Deerfield.
Northfield, No. 3,	T. R. Callender, Northfield.	Mrs. N. D. Alexander, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	Wm. A. Woods, Groton, R. F. D., No. 2.	M. S. Sawyer, Groton, R. F. D., No. 2.	Mary Dresser Boynton, Box 47, Groton.
Conway, No. 8,	W. T. Graves, Conway.	Mrs. L. T. Hopkins, Conway, R. F. D.	Mrs. J. H. Antes, Conway.
Barre, No. 9,	John Hancock, Barre.	Mrs. Elsie E. Smith, Barre.	James M. Washburn, Barre.
Pittsfield, No. 14,	John H. Noble, 309 Holmes Road, Pittsfield.	Mrs. John H. Noble, 309 Holmes Road, Pittsfield.	Winthrop D. Crosier, 23 Myrtle St., Pittsfield.
"Hope" of Hadley, No. 15,	Frank P. Wheeler, Hadley.	Mrs. Austin E. Cook, Hadley.	Leslie R. Smith, Hadley.
Amherst, No. 16,	Edwin F. Gaskill, Amherst.	Prof. F. C. Sears, Amherst.	Miss Mary H. Scott, Amherst.
Cheshire, No. 17,	Orrin C. Martin, Cheshire.	Mrs. J. G. Bennett, Cheshire.	Mrs. Maude L. Purdy, Cheshire.
Hinsdale, No. 19,	C. E. Robinson, Cheshire.	Miss Hattie Tracy, Hinsdale.	T. Augustus Frissell, Hinsdale.
Westfield, No. 20,	Eugene DeWitt Herrick, Westfield.	Mrs. C. M. Gardner, Westfield.	Miss Henrietta L. Thomas, Westfield.
Lanesborough, No. 21,	W. E. Foster, Lanesborough.	Miss E. J. Tillotson, Lanesborough.	Mrs. Ella Foster, Lanesborough.
Worcester, No. 22,	Burt W. Greenwood, 193 May Street, Worcester.	Mrs. Alice G. Forbes, Blithewood Ave., Worcester.	Mrs. Nancy E. Moore, 92 Summer St., Worcester.
Dalton, No. 23,	Herbert B. Brown, Dalton.	James E. Barden, Dalton.	Miss Yensie A. Packard, Dalton.
Blandford, No. 24,	A. H. Nye, Blandford.	I. E. Whitney, Blandford.	Miss Bertha Richards, Blandford.
New Lenox, No. 26,	Horatio H. Sears, New Lenox.	Miss Gertrude Mattoon, New Lenox.	Mrs. Carrie Hutchinson, New Lenox.
Easthampton, No. 27,	Fred E. Frost, S. Main St., Easthampton.	W. H. Hannum, West St., Easthampton.	Miss Lillian A. Russell, 15 Prospect St., Easthampton.
Richmond, No. 32,	Mrs. R. P. Coleman, Pittsfield, R. F. D.	Jesse H. Fairfield, Jr., Richmond.	Miss Ida H. Barnes, Richmond.
Adams, No. 34,	Daniel E. Upton, Adams, R. F. D.	Mrs. L. E. Dudley, Adams, R. F. D.	Mrs. Sara Fleming, Orchard St., Adams.

Russell, No. 36,	A. B. Copeland, Russell.	Mrs. Minnie Russell.	Miss Edith H. Gushee, Russell.
"Thrifty" of Leverett, No. 37,	C. H. Beeman, Leverett.	Miss Stella Ingram, Hillsborough.	F. N. Bourne, North Leverett.
Granville, No. 40,	Silas B. Root, Granville.	Mrs. Harry S. Hartley, Granville.	Lawrence F. Henry, Granville.
Montgomery, No. 45,	Walter D. Allyn, Montgomery.	Miss Helen Kelso, Montgomery.	Miss Florence Moore, Montgomery.
Southwick, No. 46,	Nelson J. Trench, Southwick.	Mrs. F. D. Lambson, Southwick.	Mrs. N. J. Trench, Southwick.
Becket, No. 47,	Howard R. Molineux, Becket.	Mrs. C. E. Lyman, Becket.	Arthur H. Capen, Becket.
"Highland" of Huntington, No. 48.	Wm. E. Wright, Norwich.	Mrs. S. C. Wilbur, Huntington.	E. F. Goodwin, Huntington.
"Granite" of South Worthington, No. 49.	Rufus H. Adams, Ringville.	Mrs. Hattie Thrasher, S. Worthington.	Mrs. Helen Drake, Huntington.
"Golden Rule" of Prescott, No. 52.	Chas. W. Berry, Greenwich Village, R. F. D.	Mrs. J. Etta Allen, Greenwich Village, R. F. D.	Mrs. Fanny G. Thayer, Greenwich Village, R. F. D.
Sterling, No. 53,	Fred R. Trask, Pratt's Junction.	Mrs. Emily B. Graham, Pratt's Junction.	Robert P. Trask, Pratt's Junction.
Springfield, No. 54,	A. E. Perkins, 69 Union St., Springfield.	Mrs. Mary P. Nettleton, 812 Main St., Springfield.	Mrs. Lillian A. Cornell, 307 Main St., Springfield.
Cummington, No. 56,	Denison C. Morey, Cummington.	Mrs. D. C. Morey, Cummington.	W. E. Ford, Cummington.
Auburn, No. 60,	H. J. Marcy, Auburn.	Mrs. Alice E. Keep, Auburn.	Mrs. E. W. Barrows, Box 806, Worcester.
Egremont, No. 63,	Ray W. Spurr, Great Barrington, R. F. D., No. 3.	Mrs. H. P. Loring, Great Barrington, R. F. D., No. 1.	Chester G. Dalzell, South Egremont.
"Union" of Belchertown, No. 64,	Myron G. Ward, Belchertown.	Miss Bertha M. Peeso, Belchertown.	Mrs. Lillian Kelley, Belchertown.
Brimfield, No. 65,	Clarence B. Brown, Brimfield.	Mrs. B. A. Garms, Brimfield.	Mrs. Mary Hitchcock, Brimfield.
Charlemont, No. 66,	D. J. Davenport, Charlemont.	C. T. Haskins, Charlemont.	Mrs. Belle E. Mayhew, Charlemont.
Hardwick, No. 67,	Miss Annie D. Knight, Hardwick.	Miss Flora B. Bradford, Hardwick.	Miss Mabel S. Barnes, Hardwick.
Shelburne, No. 68,	Wm. J. Purrington, Shelburne.	Mrs. C. S. Bardwell, Shelburne.	Earl A. Newhall, Shelburne.
Ashfield, No. 69,	Allison G. Howes, Ashfield, R. F. D.	Mrs. Sanford Boice, South Ashfield.	Mrs. Joseph Tatro, Shelburne Falls, R. F. D.
Phillipston, No. 70,	Fred A. Lincoln, Phillipston.	Mrs. Mary R. Chaflin, Phillipston.	Mrs. Cora A. Dunton, Phillipston.
Leyden, No. 71,	W. A. Campbell, Greenfield, Care Leyden Stage.	Mildred E. Severance, Bernardston, R. F. D., No. 2.	C. F. Severance, Bernardston, R. F. D., No. 2.
"Prescott" of Pepperell, No. 73,	Fred S. Bancroft, Box 148, Pepperell.	Miss Sarah B. Tucker, Box 59, Pepperell.	Miss S. Luella Parker, East Pepperell.
Colrain, No. 76,	Earl M. Nichols, Lyonsville.	Mrs. Wm. M. Stacy, Shattuckville.	Anna May Gilchrist, Colrain.
Windsor, No. 77,	Jesse A. Miner, Cummington.	Mrs. O. D. Jacobs, East Windsor.	Mrs. Belle Miner, Cummington.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Holden, No. 78,	Hermon E. Moore, Holden, R. F. D.	Mrs. Sophronia Hubbard, Holden.	Mrs. Ina M. Stanhope, Holden.
Spencer, No. 79,	Arthur Monroe, Spencer.	J. R. Kane, Spencer.	J. W. Bigelow, Spencer.
Bernardston, No. 81,	M. L. Corbett, Bernardston.	Mrs. Mary L. Corbett, Bernardston.	Mrs. E. B. Hale, Bernardston.
"Manhan" of Southampton, No. 82.	C. S. Hooker, Holyoke, R. F. D.	Mrs. C. S. Hooker, Holyoke, R. F. D.	Mrs. C. P. Gridley, Box 176, Southampton.
Chesterfield, No. 83,	Victor M. Pearl, Bisbees.	Mrs. I. M. Baker, Bisbees.	Miss Genie Pyncheon, Chesterfield.
Warwick, No. 85,	Geo. A. Witherell, Warwick.	Lilla M. Prouty, Warwick.	Eva Williams, Warwick.
North Orange, No. 86,	Wm. A. Taylor, North Orange.	C. Fred Miller, North Orange.	Golan A. Miller, North Orange.
Buckland, No. 87,	Eugene D. Griswold, Buckland.	Warren D. Forbes, Shelburne Falls.	Henry B. Wells, Shelburne Falls.
Lee, No. 88,	Charles H. Shaylor, Lee, R. F. D.	Mrs. W. A. Dikeman, Lee.	Mrs. W. M. Shaylor, Lee.
Worthington, No. 90,	Alden N. Curtis, Worthington.	Elmer N. Curtis, Worthington.	Miss Nellie C. Shipman, W. Worthington.
Charlton, No. 92,	Edward M. Bowers, Charlton Depot.	Ida E. Taylor, Dodge, R. F. D.	Mrs. Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	Mrs. Lizzie Harrington, North Grafton.	Mrs. Lizzie Johnson, North Grafton.	Mrs. Eva M. Sibley, Grafton.
Petersham, No. 95,	Geo. K. Wilder, Petersham,	Preston R. Crowell, Petersham.	Mrs. Ruby J. Stone, Petersham, R. F. D.
Savoy, No. 99,	Warren S. Hathaway, Savoy.	Mrs. William McCulloch, Savoy.	Mrs. C. A. Maranville, Savoy.
Shrewsbury, No. 101,	Walter E. Brigham, Shrewsbury, R. F. D.	Miss Georgie Bailey, Shrewsbury.	Mrs. Emily A. Carey, Shrewsbury.
Stow, No. 103,	Shervington Vance, Stow.	Rev. J. S. Moulton, Stow.	Mrs. Fannie A. Stevens, West Acton, R. F. D.
"Garfield" of No. Dana, No. 104,	Clarence Eddy, North Dana.	Mrs. L. Flora Brown, North Dana.	Edwin C. Matthews, North Dana.
Marlborough, No. 105,	H. F. Wilder, 73 Tremont St., Marlborough.	F. Howard Brown, Hosmer St., Marlborough,	Mrs. E. D. Howe, Union St., Marlborough.
Millbury, No. 107,	Oscar H. Stowe, West Millbury.	Mrs. Robert J. Stockwell, West Millbury.	Miss Susan A. Hayward, Millbury, R. F. D., No. 3.
Hudson, No. 108,	Alfred L. Ordway, Hudson.	Mrs. Mary L. Eddy, Hudson.	Mrs. Mary E. Lawrence, 55 Lincoln St., Hudson.
Sutton, No. 109,	Wallace F. King, Sutton, R. F. D.	Mrs. Marion G. Putnam, Sutton, R. F. D.	Miss Sarah M. Mills, Sutton, R. F. D.
Sherborn, No. 110,	E. C. Barber, Sherborn.	O. H. Howe, South Sherborn.	Miss A. H. Daniels, South Sherborn.
Boylston, No. 111,	Chas. S. Knight, Boylston Centre.	Mrs. Abbie D. Flagg, Boylston, R. F. D.	Mrs. Edna J. Garfield, Boylston, R. F. D.

"East Medway" of Millis, No. 112.	Edward E. Adams, Millis.	Mary C. Fuller, Millis.	Fred H. Holland, Jr., Millis.
Framingham, No. 113,	J. M. Harrington, South Framingham, R. F. D., No. 3.	Mrs. Agnes Lummus, Framingham.	Geo. E. Fay, S. Framingham, R. F. D., No. 2.
Medfield, No. 114,	Mrs. Sadie Dewar, Medfield.	Mrs. Cora G. Kennett, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	Warren E. Coolidge, Holliston.	Miss Elizabeth Champney, East Holliston.	Mrs. Nellie V. Pope, Lock Box 31, Holliston.
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TWENTY-FIRST ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

PART II.,

BEING PART IV. OF THE FORTY-SIXTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

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TWENTY-FIRST ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

PART II.

GENERAL REPORT OF THE EXPERIMENT STATION.

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PART II.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION

OF THE

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TWENTY-FIRST ANNUAL REPORT.

Part II.

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Edward B. Holland, M.S., Associate Chemist, 28 North Prospect Street.
Henry D. Haskins, B.Sc. Chemist (Fertilizer Control), 89 Pleasant Street.
Philip H. Smith, B.Sc., Chemist (Food and Dairy Control), 102 Main Street.
Fred C. Sears, M.S., Pomologist, Mt. Pleasant.
Erwin S. Fulton, B.Sc., Assistant Agriculturist, 12 Cottage Street.
Edwin F. Gaskill, B.Sc., Second Assistant Agriculturist, R. J. Goldberg's, North Pleasant Street.
Robert D. MacLaurin, Ph.D., Assistant Chemist, Research Division, 6 Kellogg Street.
Lewell S. Walker, B.Sc., Assistant Chemist, 19 Phillips Street.
George H. Chapman, B.Sc., Assistant Botanist, 15 Amity Street.
Philip V. Goldsmith, B.Sc., Assistant Chemist, 32 North Prospect Street.
Jas. C. Reed, B.Sc., Assistant Chemist, 66 Pleasant Street.
Jacob K. Shaw, M.S., Assistant Horticulturist, 9 Amity Street.
J. N. Summers, B.Sc., Assistant Entomologist, 66 Pleasant Street.

F. A. JOHNSON, B.Sc., Assistant Entomologist, Cranberry Investigations, 84 North Pleasant Street.

FRED C. KENNEY, Treasurer, Mt. Pleasant.

CHARLES R. GREEN, B.Agr., Librarian, Mt. Pleasant.

ROSE J. BROWN, Secretary, Draper Hall, Massachusetts Agricultural College.

WILLIAM K. HEPBURN, Inspector, Feed and Dairy Division, Sunderland.

ROY F. GASKILL, Assistant in Animal Nutrition, Massachusetts Agricultural College.

R. C. LINDBLAD, Observer, 20 South College, Massachusetts Agricultural College.

JESSIE V. CROCKER, Stenographer, Department of Botany and Vegetable Pathology, Sunderland.

HARRIET COBB, Stenographer, Department of Plant and Animal Chemistry, 33 Cottage Street.

BRIDIE E. O'DONNELL, Stenographer, Department of Entomology, South Hadley.

REPORT OF THE DIRECTOR.

The general work of the Massachusetts Agricultural Experiment Station during the past year has followed the usual lines, but there has been a considerable increase in the amount of work in all the various departments of its activities. There has been no increase in the number on the station staff, but notwithstanding this fact there has been a considerable increase in the amount of purely experimental and research work as well as in the amount of work done in connection with the fertilizer, feed and dairy laws and in meeting the requests of our public for analytical work and for advice and information. This increase has been made possible chiefly through better organization in the chemical department.

Changes in Staff.

The station has been fortunate in retaining the services of all heads of departments. The official connection of Prof. E. A. White, B.Sc., with the station as floriculturist terminated September 1. At the same time Prof. F. C. Sears, M.Sc., became pomologist to the station. This change seemed desirable in view of the fact that while the floricultural interests of the State are important, those of fruit culture would seem to be yet more important. Professor White's connection with the college, however, remains unchanged, and he can accordingly still be consulted on such special problems connected with floriculture as are brought before us.

The following changes affecting subordinate positions have been made during the year: —

James C. Reed, B.Sc., and P. V. Goldsmith, B.Sc., have been engaged as assistants in the department of chemistry, in place of E. T. Ladd, M.Sc., and Walter E. Dickinson, B.Sc., resigned during the latter part of last year.

J. K. Shaw, B.Sc., has been engaged as assistant in the department of horticulture, in place of C. S. Pomeroy, B.Sc., who resigned to accept a more responsible and lucrative position.

F. A. Johnson, B.Sc., has been engaged as assistant in entomological work on cranberry insects, in place of H. J. Franklin, Ph.D., who resigned to accept a more important position in another institution.

Buildings.

During the past year the shed referred to in my last annual report for use in connection with the asparagus work at the substation in Concord has been completed, at a total cost of $298.

The hothouse designed for use in connection with the work of the department of vegetable physiology and pathology has been completed. This building is 70 by 28 feet in size. This was not put up under contract, but under college management by direct purchase of materials and employment of workmen. The building has been paid for by the use of funds appropriated by the Legislature for the erection and equipment of Clark Hall. The cost of the hothouse and of the passages connecting it with the main building has been about $3,000. This hothouse has been but recently completed. It will make it possible for the department of vegetable physiology and pathology once more to take up numerous lines of investigation which it has not been possible to prosecute during the past year, and which were necessarily discontinued at the time of the removal from the old quarters of the department to the new, a little more than a year ago.

Much-needed additional room in the chemical laboratory for control and research work has been obtained by removing from the feed and research laboratories the machinery and fixtures used in grinding and preparing substances for analysis, for testing Babcock glassware and for making the Babcock test. This machinery and apparatus have been set up in a basement room fitted for the purpose, and all these lines of work are now carried on under conditions far more satisfactory than formerly. The cost of the needed changes has been met from current station funds.

During the past year the building formerly used for office and laboratory purposes by the department of vegetable physiology and pathology has been put into thorough repair and refitted for use by the department of agriculture, for administrative headquarters and offices. The most important change consists in the provision of fireproof rooms for storage of records, papers and the more valuable files of station and government publications. One-quarter of the building has been rebuilt, with the exception of the exterior walls, which were originally of brick, on the lines of the usual vault construction. This part of the building contains three rooms, each about 11 by 12 feet in size, two of them provided with wire-glass windows and steel shelving, and all with heavy vault doors. In addition to this change the basement floor has been concreted and the ceiling plastered, new floors have been laid throughout the building; new windows have been provided in place of the old on the entire second floor, the walls throughout the building have been refinished, and a number of minor changes and improvements have been made. The cost of these improvements, as well as of some much-needed repairs and improvements in the chemical laboratory, has been met by the State appropriation of $4,000, made by the last Legislature.

Station Activities.

There will be general agreement that the objects primarily in view in the establishment of experiment stations were: (1) to provide for the carrying out of experiments whose results should make possible definite and decisive answers to as many as possible of the unsettled questions affecting agricultural practice; (2) to provide an agency which by true research should endeavor to broaden the bounds of human knowledge, especially in the field of the sciences, and particularly in their relations with and application to agriculture; (3) to disseminate useful information having a bearing upon agriculture and the welfare of the people, and especially the people of the rural districts; (4) in addition, this station has been charged with the execution of several control laws. Those at present in force relate to the trade in fertilizers, feed stuffs and the apparatus used in making the Babcock test; and provide,

moreover, for the inspection of the machinery used in making this test in creameries and the examination of those desiring to qualify for carrying it out.

To discover and demonstrate the value of new and better methods in agriculture as an art; to test and introduce new and better varieties or species of plants and animals; to improve plants and animals by selection and breeding; to broaden our knowledge of the influences of air, water, electricity, light, heat and cold on plants and animals in health and disease; to add to our knowledge of the chemistry and physics of soils, manures and fertilizers; to increase our knowledge of foods and their functions in the animal and human economy; to make us better acquainted with the life histories of fungi and insects in their manifold relations to plants and animals and to man; these are a few among the many things coming under the first two classes which the agricultural experiment stations are striving to do. They are not, however, in most cases, the things which they are most frequently asked to do, although there can be no doubt that the interests of the great agricultural public are most advanced by new discoveries in these and similar fields.

There is no room to doubt the salutary effect of our control laws. They are recognized to be both important and useful by dealers as well as by consumers, and in carrying out the necessary inspection and looking after the strict execution of these laws the stations are rendering important service. The cost of the execution of the fertilizer law is covered by license fees paid by the manufacturers and dealers, while the execution of the feed and dairy laws is provided for by special State appropriation for that purpose. In a certain sense the execution of these laws may be regarded as outside of the special lines of work for which the experiment stations were founded. There is doubtless danger, moreover, that such work will be allowed to interfere with the more appropriate work of the station. In the early days of experiment stations it was undoubtedly an advantage that the stations should be charged with the execution of these laws. This arrangement served to bring the station and the farmers into closer touch, and, moreover, the station laboratories were equipped with the apparatus

and the men necessary for carrying on the work, which at that time was not true of any other existing State institution. These reasons do not now have equal force, but as the station has been so developed both on the side of material and personal equipment as to provide for this work, it would seem best that these laws, at least for the present, be executed by the station. It would seem best, indeed, that the station be charged also with the execution of such additional control laws as shall in the future become desirable. Already we may anticipate the wisdom or necessity of laws to control the trade in seeds, in insecticides and fungicides, and perhaps in still other directions. Laws to control the trade in insecticides and fungicides are already much needed. National and State authorities and the manufacturers have for some time been studying this subject. It is hoped that in the near future a law which seems likely to prove mutually satisfactory will be agreed upon, and it seems wise, therefore, to defer State action until such a law can be framed, or until it becomes apparent that the necessary understanding cannot be reached. Uniformity in the laws affecting the trade in these materials throughout the Union is greatly to be desired, on account of the fact that it is not confined within State lines. Most of the manufacturers undoubtedly do an interstate business.

It is service coming under the third of the three classes which I have enumerated which appears at present to be most appreciated, and which is most in demand. Under this class must be placed such diverse activities as the publication of reports, bulletins and circulars, answering letters of inquiry, preparation of articles for the press, practical demonstrations and object lessons, exhibitions at fairs, and lectures by members of the station staff. Under this class must be placed, also, the various requests for information which can be given only after analyses or other special laboratory examinations or tests. The amount of time consumed in meeting the demands of the public for work of this description is very great, and so rapidly does the demand for service along these lines increase, that there is undoubtedly great danger that the time available for experiment and research may be seriously curtailed. The following summary will give a general idea of the amount of work in-

volved in meeting this demand, and in the execution of the control laws which have been referred to: —

Summary of Station Work not Experimental.

Dissemination of information and work for individuals: —	
Publications of the year 1908: —	
Reports,	1
Bulletins,	8
Circulars,	8
Answers to letters of inquiry,	8,000
Lectures and demonstrations by members of the staff,	67
Exhibits at fairs,	2
Miscellaneous analyses: —	
Water,	143
Milk,	625
Cream,	2,899
Feed stuffs,	122
Fertilizers and fertilizer materials,	169
Soils,	33
Miscellaneous substances,	26
Tests of cows: —	
Yearly,	76
Seven day,	68
Fourteen day,	5
Thirty day,	10
Forty-four day,	6
Miscellaneous: —	
Tests of seeds for germination,	196
Tests of seeds for purity,	12
Separation of seed,	160
Control work: —	
Fertilizers, samples analyzed,	624
Feeds, samples analyzed,	895
Babcock apparatus, pieces tested,	2,713
Candidates examined,	23

This statement makes it apparent that these lines of work, many of which are undertaken on the request of individuals, and which are of such a nature that the results are of value chiefly or exclusively to the particular individual concerned and of little or no interest to the public, must make very heavy inroads both upon station funds and upon the time of members of the station staff. The members of our staff are unfailingly

glad to help individuals to the utmost of their ability in so far as is consistent with their obligations to render service which is of wider interest and importance. Individuals should remember that the station is supported by public funds, in the interest of the public. The public funds are a public trust, and station men must first of all and chiefly work in the public interest.

That the bearing of this general principle may be made more apparent, and in the hope that individuals may be led thereby to exercise a wiser discretion in the demands they make upon the station, a brief consideration of the usefulness and limitations of some of these lines of work as well as of the extent to which they can be undertaken will be presented.

Publications.

Our publications are chiefly of three kinds, — annual reports, bulletins and circulars. These are designed primarily to present the results of investigations carried on in the various departments of the station, and to convey practical advice based upon these results or upon the results of others. The bulletins are sent without charge, so long as the supply lasts, to all citizens of the State whose names are on our mailing list, or who may apply for them. They are also sent to all libraries in the State which will care for them, to the newspapers, to members of agricultural college and station staffs, and to many persons all over the world who apply for them.

This year, for the first time, the annual report is to be published in two parts, — popular and general. This change has been made in order that those portions of the report which are believed to be of widest popular interest may be given a more general circulation. The number of annual reports heretofore available for distribution from the station has been 6,000, and it has not been possible to send it to all those on our mailing list. Hereafter we are to have 16,000 copies of the popular portion, and this will be sent to all on our general State list. We are to have 4,000 copies of the general report, and this will be sent to libraries, workers in other experiment stations and, so far as possible, to such as apply for it. Fifteen thousand copies of this part of our report will be bound with

the report of the secretary of the State Board of Agriculture, and distributed in that form from the office of the Board.

The circulars, which briefly treat subjects of wide interest, as made evident by correspondence, are used chiefly in answers to letters of inquiry.

Publications during 1908.

Annual report: —

Contains report of the director, treasurer and heads of departments, with papers on a number of miscellaneous subjects. 172 pages.

Bulletins: —

No. 119. Inspection of Commercial Fertilizers, H. D. Haskins, E. T. Ladd and W. E. Dickinson. 64 pages.
No. 120. Inspection of Commercial Feed Stuffs, P. H. Smith and L. S. Walker. 48 pages.
No. 121. Seed Separation and Germination, G. E. Stone. 16 pages.
No. 122. Poultry Keeping for Egg Production, Wm. P. Brooks. 64 pages.
No. 123. Fungicides and Insecticides and Spraying Directions, G. E. Stone and H. T. Fernald. 32 pages.
No. 124. Bee Diseases in Massachusetts, Burton N. Gates. 12 pages.
No. 125. Shade Trees, E. A. Start, G. E. Stone and H. T. Fernald. 64 pages.
No. 126. How to fight Cranberry Insects, H. J. Franklin. 12 pages.
No. 127. Inspection of Commercial Fertilizers for Season of 1908, H. D. Haskins, L. S. Walker and J. C. Reed. 68 pages.

Circulars: —

No. 12. The Unprofitable Cow and how to detect Her. 4 pages.
No. 13. Laws regulating the Sale of Commercial Fertilizers in Massachusetts, J. B. Lindsey. 4 pages.
No. 14. Fertilizers for Potatoes, Wm. P. Brooks. 4 pages.
No. 15. The Cost of testing Pure-bred Cows, J. B. Lindsey. 2 pages.
No. 16. Seeding Mowings, Wm. P. Brooks. 8 pages.
No. 17. An Act to regulate the Sale of Concentrated Commercial Feed Stuffs, J. B. Lindsey. 4 pages.
No. 18. Alfalfa as a Crop in Massachusetts, Wm. P. Brooks. 4 pages.
No. 19. The White Fly, C. E. Hood. 2 pages.

Publications available for Free Distribution.

Bulletins: —

No. 33. Glossary of Fodder Terms.
No. 41. On the Use of Tuberculin (translated from Dr. Bang).
No. 64. Analyses of Concentrated Feed Stuffs.

No. 68. Fertilizer Analyses.
No. 76. The Elm-leaf Beetle.
No. 83. Fertilizer Analyses.
No. 84. Fertilizer Analyses.
No. 89. Fertilizer Analyses; Ash Analyses of Plants; Instructions regarding Sampling of Materials to be forwarded for Analysis.
No. 90. Fertilizer Analyses.
No. 92. Fertilizer Analyses.
No. 97. A Farm Wood-lot.
No. 103. Analyses of Manurial Substances; Instructions regarding Sampling of Materials to be forwarded for Analysis; Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers; Discussion of Trade Values of Fertilizing Ingredients.
No. 113. Fertilizer Analyses.
No. 115. Preliminary Report on Cranberry Insects.
No. 116. The San José Scale.
No. 117. Trade Values and Fertilizer and Soil Analyses.
No. 120. Inspection of Commercial Feed Stuffs.
No. 121. Seed Separation and Germination.
No. 122. Poultry Keeping for Egg Production.
No. 123. Fungicides and Insecticides and Spraying Directions.
No. 124. Bee Diseases in Massachusetts.
No. 125. Shade Trees.
No. 126. How to fight Cranberry Insects.
No. 127. Fertilizer Bulletin for Season of 1908.
Technical Bulletin No. 2. The Graft Union.
Technical Bulletin No. 3. The Blossom End Rot of Tomatoes.
Index to bulletins and annual reports of the Hatch Experiment Station published previous to June, 1895.
Index to bulletins and reports, 1888–1907.

Annual reports: —
Annual reports of the station are available for the years 1898 (9th) to 1908 (20th) with the exception of 1907 (19th).

Of some few other bulletins we have a very limited supply. These will be furnished only in order to complete sets for libraries. Circular No. 8, which gives a complete list of bulletins published by this station up to March, 1907, will be sent on application.

Extent and Nature of Demand for Publications.

The demand for station publications has greatly increased. Our editions of bulletins treating subjects of general interest now reach 25,000. Our annual expenditure for publications and distribution of bulletins and circulars now amounts to rather more than $3,000.

Almost every mail brings requests for bulletins of information. These requests cover the whole field of agriculture. Correspondents within the last few days, for example, have called for "your pamphlet," "manual," "work" or "bulletin" on asparagus, orchard management, potato growing, duck raising, strawberry culture, small fruit growing, management of hot-house crops, etc. Whatever the line of work, the public looks to the station for literature exhaustively treating the subject. It is manifestly impossible to meet any considerable proportion of such requests under present conditions. We have published no comprehensive manuals for the different farm and garden specialties. It may be questioned whether the publication of such manuals would be the wisest use either of station talent or funds. It is freely granted that such manuals, carefully prepared, would be useful, they would meet a want; but is it not reasonable to leave something for private enterprise? Should not the members of the farming public, as well as other citizens, satisfy their requirements in this direction by purchase? May we not safely depend upon the agricultural publishers to furnish works of this character? However these questions may be answered, it is certain that under existing conditions the station cannot engage in the preparation, publication and gratuitous distribution of any considerable number of manuals on our various specialties.

Letters of Inquiry.

Thousands of letters of inquiry are received at the station annually. Every head of department has repeatedly called attention to the increase in the numbers of such letters and the heavy demands upon the time and energy which answering such letters entails, involving as the preparation of answers in many cases does a considerable amount of investigation. The

fact that our public more and more looks to the station to settle doubtful points and to give desired information and help is gratifying; and until satisfactory, special provision can be otherwise made for work of this kind, the members of the station staff will gladly meet the demand to the best of their ability. The circulars which have been elsewhere referred to are proving of great assistance in meeting requests for information and advice.

In conclusion on this topic I would like to emphasize these points: —

1. This work, from its very nature, is primarily for the benefit of individuals and often of no general interest. Individuals therefore should refrain from sending inquiries which can as well be answered by reference to standard works or to other channels of information.

2. It is impossible for station officials in most cases to give business advice. They cannot know, for instance, whether A can make the hen business profitable in the town of X; nor whether B will succeed in producing cranberries at a profit in the marshes of the county of W.

3. Letters of inquiry should refer to specific problems. It is clearly not within the bounds of possibility to discuss general problems with results satisfactory either to the writer or to the receiver within the limits of a letter. A common type of letter received runs somewhat as follows: —

Dear Sir: — I have recently inherited [or purchased] a farm situated in the town of ——. This farm was formerly productive, but has been neglected and the soil is much exhausted. Will you not kindly tell me how it may be so handled as to restore it to fertility and at the same time return a profit to the owner?

The discussion of the problems thus presented would involve the whole field of agricultural science and practice. The problems are important and the need of the individual is great. It cannot, however, be met through the channels of ordinary correspondence. The most we can do is to refer to sources of information, or to advise either a short winter course or a correspondence course in agriculture.

Miscellaneous Analyses.

The summary presented shows that a large number of miscellaneous analyses have been made during the past year. Had the individuals and associations sending in these materials paid for the analyses at current commercial rates, the cost to them must have amounted to between $5,000 and $6,000. It is not the policy of the station to invite commercial work, and we do not accept it except in cases where it appears to be almost a necessity that the station make the desired analyses. Such analyses are made without charge for individuals in all cases where the results are likely to be of some public interest. Indeed, we do not limit our free work strictly in accordance with this rule, as we believe it to be good general policy to encourage the spirit of study and inquiry which the desire for such analyses usually indicates.

A few words in explanation as to the attitude of the station as regards the analysis of different classes of materials for the public seem called for.

Water Analyses. — The station makes a uniform charge of $3 for a sanitary analysis of drinking water. This is much below the usual charge for such work, which varies widely, but will probably average at least $10. The results of water analysis are of interest and value, as a rule, only to the individual sending in the sample. So long as these analyses were made without charge the number of samples sent in was so large that the work of making the analyses became a great burden and seriously interfered with other work. It is not believed that the charge now made is sufficiently high to deter parties from sending samples for analysis in cases of necessity. The charge does, however, act as a check upon the indiscriminate forwarding of samples, and this was the result aimed at.

Analyses of Milk and Cream. — Under existing laws in this State the station determines fat or fat and solids in samples of milk and cream at cost for creameries. Farmers' occasional samples are analyzed without charge.

Analyses of Feeds and Fertilizers. — The total number of samples of feeds, fertilizers and fertilizer materials analyzed during the year has been considerable, and this work is becom-

ing something of a burden. Individuals should consult the station publications, in which analyses of identical materials will often be found, before sending in samples or writing for analyses. The inspection service of the station is now so thoroughly organized that there are relatively few materials coming under these classes which have any considerable importance that are not officially collected and analyzed. In all cases, however, where individuals desire to purchase either feeds or fertilizers on a guaranty of composition to be determined by station analysis, the station holds itself in readiness to make such analyses as are needed, and will undertake to do this work and to report results with all possible promptness in all cases where the quantity involved is large enough to make the work worth while. Such analyses will be made without charge, if parties desiring them conform with the instructions sent.

Analyses of Soils. — During the past year there has been a very great increase in the number of requests for chemical analyses of samples of soils. It is evident that there exists a widespread misapprehension as to the value of such analyses. It appears to be believed that it is necessary only to make a chemical analysis in order to determine what fertilizers will be required. The following letter, received within a few days, fairly represents the attitude of most correspondents relative to this work: —

GENTLEMEN: — I write for information for Mr. ——, the owner of a large farm in ——, Mass. He wishes to know if he can send you samples of soil for analysis; most likely would send 8 or 10 samples from different parts of his farm. In what form and in what quantity should he send, and what would be the expense for analysis of each package sent? He would also like to know what crop would produce the best results for each sample sent, and the best fertilizer for each sample and the quantity required, and would be pleased to pay for any catalogue or information in circular form you can furnish him on scientific farming. . . .

The views which we hold relative to the possible value of such work, and the attitude of the station in relation to it, will perhaps be made clear by the following quotation from a circular on the subject: —

The results of chemical analysis of soils do not, as a rule, afford a satisfactory basis for determining manurial requirements. The chemist, it is true, can determine what the soil contains, but no ordinary analysis determines with exactness what proportion of the several elements present is in available form for the crop. Indeed, there is no such thing as a constant ratio of availability. While one crop may find in a given soil all the plant food it requires, another may find a shortage of one or more elements. Further, on the very same field one crop will find an insufficient amount of potash, another may find enough potash for normal growth but insufficient phosphoric acid, and a third may suffer from an insufficient supply of nitrogen.

Most of our soils are of mixed rock origin, and as a rule possess similar general chemical characteristics, provided they have been farmed under usual conditions. The manurial and fertilizer requirements are determined more largely in most instances by the crop than by peculiarities in the chemical condition of the soil. The chemical analysis of soils, then, does not, as a rule, afford results which have a value commensurate with the cost, and as a rule this station will not make such analyses unless the soil differs widely from the normal in natural characteristics, or has been subjected to unusual treatment of such a nature as to probably greatly influence its chemical condition.

In some cases the correspondent reports that his crop is diseased and that he desires a chemical analysis in order to ascertain what is the cause. The chemical composition of the soil may in some instances exercise a controlling influence in determining a condition of health or disease, and is never unimportant from the standpoint of vigorous, normal and healthy growth; but in the case of most diseases the immediately active cause is the presence of a parasitic fungus, and this fungus is usually capable of fixing itself upon the plant whatever may be the composition of the soil. A knowledge of the chemical composition of soils, therefore, will not make it possible to advise such manurial or fertilizer treatment as will insure immunity from disease.

It will be noted that the correspondent quoted evidently believes that the chemical composition of the soil will determine its suitability for different crops. The chemical composition may not be without importance in determining what the soil is fitted to produce, but the physical characteristics of the soil and subsoil, as affecting drainage, the capacity to hold water, the capacity to conduct water from below upwards, texture and aeration, are of much greater importance in determining what crops the soil is fitted to produce. It will be noted that the correspondent expresses a willingness to pay the cost of analysis. Very many express themselves to that effect. The fact that

this is the case does not, however, and should not change our attitude relative to such work. We believe that the results would not have the value which correspondents suppose they would have, and it therefore seems best to decline to make such analyses except in cases where conditions widely different from those which usually prevail seem to render it probable that the results will possess unusual value.

Analyses of Miscellaneous Substances. — A wide variety of materials coming under this class is offered for analysis each year. Materials of such a character as render analysis likely to prove of especial interest or value in our agriculture will be analyzed without charge, but it should be here stated that the station cannot undertake the analysis of ores and minerals.

Testing Cows.

The conditions under which pure-bred cows are tested are set forth fully in the report of the head of the department of chemistry. The director desires to call attention here simply to the fact that since such tests involve a large amount of detail work, and since they appear to be conducted primarily for the private interest of the individuals owning the cows, it is regarded as only proper that the station should be fully reimbursed for the cost of doing the work. It has been found necessary during the past year to make a small increase in the amount charged.

Seed Work.

Tests of seeds for germination and for purity, when asked for by farmers or gardeners, are made without charge. The number of requests for seed testing is increasing quite rapidly. In a number of instances seedsmen call upon us for similar work, preferring to have it done by the station rather than to undertake it themselves. Since it is highly desirable that seedsmen should be encouraged by all possible means to offer only seeds whose quality is well known, the station will for the present undertake such work, which will be charged at cost. Samples of seeds from farmers or gardeners brought in for separation are subjected to treatment without charge. Should

seedsmen call upon us for work of that character, our policy would be the same as in reference to tests for germination and purity.

Mailing Lists.

The persons on our general lists and receiving our publications regularly may be classified as follows: —

Residents of Massachusetts,	14,705
Residents of other States,	2,045
Residents of other countries,	174
	16,924

During the year we have made up as full a list of bee keepers in the State as possible. Most of the addresses had been collected by Burton N. Gates, apiculturist, United States Department of Agriculture, and this list was very kindly placed at our disposal. We have made several additions as a result of correspondence and the list is now probably fairly complete.

We have made a special effort during the past year to secure the co-operation of the libraries of the State in preserving files of our publications, in order that they may be accessible for consultation in all parts of the State. Circular letters were sent to all libraries, offering to make up as complete a set of station publications for each as could be got together, calling attention to the fact that such sets must in the future be valuable for consultation, and offering to place the libraries upon our mailing list. We received many favorable replies, but in a number of instances the libraries stated that they felt obliged to decline to undertake the completion and preservation of a file of station publications on account of lack of suitable accommodations for preserving them. As a result of our correspondence, however, we added 175 libraries to our mailing list, and we made up and sent out to libraries a large number of sets of publications which were made as nearly complete as our stock of the different issues would allow.

The following special mailing lists are now in use: —

Cranberry growers,	1,507
Bee keepers,	2,510
Meteorological,	263
Libraries,	333

The total net addition to all lists during the past year has been 3,175.

Asparagus Substation, Concord.

It will be remembered that the substation work with asparagus in Concord is located on land leased of Mr. Charles W. Prescott. This work was begun in the spring of 1906. The leading lines of investigation are two: (1) breeding experiments, with a view especially to the production of a desirable type of asparagus with greater capacity to resist rust; (2) fertilizer experiments.

During the past year a new line of work has been begun in a small way, *i.e.,* experiments to determine the effects of the cultivation of asparagus under tent shade, after the manner which has been successfully followed in the production of certain grades of tobacco. This station enjoys the co-operation of the Bureau of Plant Industry of the United States Department of Agriculture in the breeding and tent experiments.

Breeding Experiments. — During the past year the number of varieties and selections of varieties of asparagus brought together has been still further largely increased. The total number of such varieties and selections now growing in the experimental plots is 105. Most of these selections have made an excellent growth. They exhibit, as might be expected, wide differences in habit and vigor of growth as well as in capacity to resist the attacks of rust. Mr. J. B. Norton, an expert of the Bureau of Plant Industry, was stationed in Concord during the latter part of the summer. He was engaged in making close observations and study of the different types, and in selecting such as seemed to possess characteristics likely to render them valuable for the purposes in view. Mr. Norton will devote most if not all of his time to work in Concord next season, and the actual work of hybridizing will then begin.

Fertilizer Experiments. — The plants in the fertilizer plots have continued to make excellent growth. Those in the different plots now exhibit considerable variation, due, no doubt, to the varying fertilizer treatment. The past season is the second season since the plants were set, and so vigorous has been their growth that commercial cutting was begun in a small way last spring. It is not deemed best to present results

at this time, for the amount cut was no doubt affected in considerable measure by the violent spring winds, which affected some plots much more seriously than others. In order to prevent injury from winds in the future a wind break, made by tacking cheese cloth to substantial posts standing about 8 feet above ground, has been put up. It is necessary, of course, to keep the cloth in position only during that period in the growth of the plants when they are peculiarly liable to injury (when the shoots are first starting).

Tent Shade Experiment. — This experiment was commenced after the cutting season was begun. The purposes in view are to note the effect of the tent upon

(*a*) The amount of rust.

(*b*) Time and rate of yield of commercial asparagus.

(*c*) The quality of the asparagus.

As the tent was in place only a portion of the cutting season the results will not be reported in detail. It may be remarked only in passing that tests of asparagus grown in the tent in comparison with the product of another portion of the same bed not shaded, which were carried out independently by a number of different parties, led to the conclusion that the tent asparagus was more tender and of better quality.

Cranberry Substations.

It will be remembered that the work with cranberries is along two lines and in two locations: (1) work with cranberry insects in Wareham; (2) fertilizer experiments in Waquoit. The work with insects has not made the progress hoped for during the past year. There are two principal causes: (1) it has been found impossible to acquire control of a cranberry bog suitable for the practical experiments in view on terms which the station can accept; (2) the resignation of Mr. Franklin, and the necessity of starting some one on the work in his place, has inevitably meant delay. There was practically no fruit on any of the fertilizer plots this year.

Substation for Orchard Experiments.

The work in the substation for orchard experiments, on the farm of Myron C. Graves in South Amherst, has been well begun. Six acres have been laid off in eight plots, containing

substantially the same number of trees in each. Each plot has received different fertilizer treatment. The entire area is subdivided in the opposite direction into four sections for different cover-crop treatment. The orchard which had been in grass for a number of years was plowed in early spring and given sufficiently frequent tillage throughout the summer to keep down weeds. The trees have made excellent growth during the season, but a few of them have been recently somewhat damaged by the browsing of deer. It is not believed, however, that the damage from this cause is serious except to a limited number of young trees, which had been set to replace a few of those originally planted.

WM. P. BROOKS,

Director.

REPORT OF THE TREASURER.

ANNUAL REPORT

OF FRED C. KENNEY, TREASURER OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1908.

The United States Appropriations, 1907–08.

	Hatch Fund.	Adams Fund.
Dr.		
To receipts from the treasurer of the United States as per appropriations for the fiscal year ended June 30, 1908, under acts of Congress approved March 2, 1887 (Hatch fund), and March 16, 1906 (Adams fund),	$15,000 00	$9,000 00
Cr.		
By salaries,	$6,359 88	$7,121 81
labor,	2,654 09	932 68
publications,	1,192 88	–
postage and stationery,	527 21	23 45
freight and express,	164 57	4 70
heat, light, water and power,	423 19	–
chemical supplies,	417 48	11 48
seeds, plants and sundry supplies,	531 33	17 50
fertilizers,	383 72	357 51
feeding stuffs,	732 97	–
library,	249 38	–
tools, implements and machinery,	155 42	16 35
furniture and fixtures,	70 27	30 00
scientific apparatus,	299 41	333 54
live stock,	324 20	–
traveling expenses,	160 28	133 95
contingent expenses,	15 00	–
buildings and land,	338 72	17 03
Total,	$15,000 00	$9,000 00

State Appropriation, 1907–08.

Cash balance brought forward from last fiscal year,	$11,533 31	
Cash received from State Treasurer,	13,500 00	
from fertilizer fees,	5,165 00	
from farm products,	2,732 07	
from miscellaneous sources,	5,762 26	
		$38,692 64
Cash paid for salaries,	$13,713 92	
for labor,	6,832 41	
for publications,	2,185 80	
for postage and stationery,	648 46	
for freight and express,	294 15	
for heat, light, water and power,	639 03	
for chemical supplies,	416 65	
for seeds, plants and sundry supplies,	751 01	
for fertilizers,	1,859 18	
for feeding stuffs,	956 12	
for library,	234 62	
for tools, implements and machinery,	134 99	
for furniture and fixtures,	85 82	
for scientific apparatus,	373 21	
for live stock,	49 51	
for traveling expenses,	1,348 05	
for contingent expenses,	12 87	
for buildings and land,	627 32	
Balance,	7,529 52	
		$38,692 64

REPORT OF THE AGRICULTURIST.

DEPARTMENT OF AGRICULTURE.

WM. P. BROOKS, AGRICULTURIST; E. S. FULTON, E. F. GASKILL, ASSISTANTS.

The work of the department of agriculture during the past year has followed the usual lines. These it will be remembered have for their principal object throwing light upon what appear to be some of the more important problems connected with the selection and method of use and application of manures and fertilizers. Much attention has been paid also to experiments designed to show the relative efficiency as sources of nitrogen and phosphoric acid of different materials which may be purchased by the farmer as sources of these elements.

The number of plots used in connection with our field work during the past year was 313. The work in the vegetation house involved the use of 384 pots. The crops used in the crop experiments in the vegetation house were Japanese millet, dwarf Essex rape, the soy bean, tobacco and tomato. The experiments with the two latter crops were carried out in the hope of throwing light on the causes of diseases or physiological troubles affecting these crops. The results are not yet conclusive. In addition to the work in the field plots and in the vegetation house we have carried on experiments in 136 closed plots. These have been for the most part used in fertilizer experiments. The results serve as a valuable check on field work.

The number of letters of inquiry answered in the department during the past year has been greater than ever before. The total is rather over 1,200, as against 824 for the year 1907.

The pressure for space from the other departments in the experiment station is so great that no attempt will be made

to present detailed reports of the different experiments in the department of agriculture. As soon as opportunity and means permit, the different lines of investigation will be taken up one by one and reported in full. Some of the more important results of the experiments which have been carried on during the past year may be briefly stated as follows: —

I. The experiment on Field A, which has for its object to determine the relative value, as sources of nitrogen, of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood, has been continued. This experiment was begun in 1890. The crop of this year was alsike clover, which, however, was considerably mixed with grass that came into the different plots. The nitrogen fertilizer giving the highest yield this year was dried blood, closely followed by nitrate of soda. Representing the yield of the latter by 100, the relative standing of the different materials used as sources of nitrogen, as compared with the plots receiving no nitrogen, as indicated by the total yields, were as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	71.67
Sulfate of ammonia,	59.86
Dried blood,	102.08
No nitrogen,	70.45

The relative increase produced by the different nitrogen fertilizers, as compared with the no-nitrogen plots for the nineteen years during which the experiment has continued, is represented by the following figures: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	81.57
Dried blood,	68.40
Sulfate of ammonia,	60.18

These figures make it apparent that the nitrate of soda has on the average given a much greater increase in crop than either of the other materials used as a source of nitrogen. Since a pound of nitrogen usually sells at a lower price in nitrate of soda than in either of the others, the wisdom of making a large use of this material as a source of nitrogen is apparent.

II. On the field where different potash salts have been under comparison for so many years the crops this year have been sweet corn and early cabbages. The former on two series of plots, the latter on three. Last year the entire field was in potatoes, and the results showed a marked dependence of the potato crop on this soil on a liberal supply of potash, the average yield of the plots to which potash was applied exceeding that on the no-potash plots by 36.96 per cent. During the past year the fields both of sweet corn and cabbages have been remarkably even, and the most striking result of the experiment is that the yield both in the case of sweet corn and cabbages is about the same on the plots to which no potash has been applied for eleven years as on any of the potash plots. The difference in favor of the potash plots has been for the corn 2.7 per cent; for the cabbages the no-potash plots average 6.33 per cent better than those receiving potash. The yield of the corn on the no-potash plots was at the rate of 48.57 bushels per acre. The yield of the early cabbages on the no-potash plots was 48,213 pounds per acre.

III. The corn crop on the field where special corn fertilizer is under comparison with a mixture richer in potash was unusually good on both fertilizer combinations. On the special corn fertilizer it was at the rate of 94 bushels of sound corn and 7,760 pounds of stover per acre. On the fertilizer richer in potash it was at the rate of 90.23 bushels of sound corn and 9,224 pounds of stover per acre. This experiment has now been continued for eighteen years. Incidentally it furnishes a very conclusive answer to the question as to whether corn can be profitably raised on fertilizers. The cost of fertilizers applied to this field, where corn and mixed grass and clover hay have alternated, each being grown for two successive years, has varied in different years from about $12 to $16 per acre. There has not been a single unprofitable crop, and the crop of the last season is the heaviest so far secured.

IV. The crop of corn produced on the south corn acre, where manure alone is under comparison with a small quantity of manure and a potash salt, was also exceptionally heavy. On the manure alone (6 cords) the rate per acre amounted to 90.43 bushels of hard grain and 8,800 pounds of stover per acre. On

the manure and potash (4 cords of the former and 160 pounds per acre of high-grade sulfate of potash) it was at the rate of 86.72 bushels of hard corn and 8,280 pounds of stover per acre. This experiment has now continued for nineteen years, corn and grass alternating during most of the time in periods of two successive years each. The manure alone gives slightly larger crops, but at a cost disproportionally greater than that of the product on the combination of manure and potash.

V. The field used in experiments comparing different phosphates was planted to late cabbages during the past season. The crop was a poor one on account of the prolonged drought. The experimental result, however, was satisfactory, as it illustrated as strikingly as in any previous year the marked dependence of the cabbage upon a liberal supply of highly available phosphoric acid. The average product of the three no-potash plots was at the rate of only 2,573 pounds per acre, all heads, both hard and soft, being included. The best results were obtained on plots to which raw bone, dissolved bone black and basic slag meal were applied, these being respectively at the following rates per acre: —

	Pounds.
Raw bone,	20,240
Dissolved bone black,	20,018
Basic slag meal,	19,120

During the past year, therefore, we have on the best plots a yield of cabbages eight times greater than was produced on the no-phosphate plots. In 1908 these same no-phosphate plots gave a yield of hay at the rate of about 4 tons to the acre, as compared with a yield only 1,200 to 1,300 pounds per acre greater on the plots to which the most soluble phosphates were applied. These facts illustrate in a striking manner the remarkable difference in the degree of dependence of the two crops (mixed grass and clover hay, and cabbages) upon the phosphoric acid content of the soil.

VI. The experiment on the nine-acre field in top-dressing grass land with manure, fine ground bone and muriate of potash, and wood ashes has been continued. The product this year of the different materials was at the following rates per acre: —

	Pounds.
Manure,	5,005
Bone and potash,	5,345
Wood ashes,	4,624

The average yield for the entire area during the past season was at the rate of 4,977 pounds per acre. The average for the entire period, 1893 to 1908 inclusive, has been 6,220 pounds. The yields this year were considerably lower than usual, especially those of rowen, and undoubtedly on account of the marked deficiency in rainfall.

VII. In the experiment comparing winter with spring application of manure the crop this year has been mixed grass and clover hay. The field was cut twice, and the averages for the plots representing the two systems of application have been as follows per acre: —

Winter Application.

	Pounds.
Hay,	6,209
Rowen,	1,227

Spring Application.

	Pounds
Hay,	6,804
Rowen,	1,409

Spring application has given substantially 10 per cent. more hay and about 14½ per cent. more rowen than winter application.

VIII. Our work with poultry has been directed principally to a comparison of the so-called dry mash with the moist mash system of feeding laying fowls. The results have not indicated any marked superiority for either. The number of eggs from the fowls receiving the moist mash has been somewhat greater than the number produced by the fowls receiving the dry mash. Whether the difference is sufficiently great to offset the greater labor cost of the moist mash system of feeding we are not yet prepared to say.

REPORT OF THE CHEMIST.

JOSEPH B. LINDSEY.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

Research division: Edward B. Holland, Robert D. MacLaurin.
Fertilizer division: Henri D. Haskins.
Feed and dairy division: Philip H. Smith.
Assistant chemists: Lewell S. Walker, James C. Reed, Philip V. Goldsmith.
Assistant in animal nutrition: Roy F. Gaskill.
Inspector: William K. Hepburn.
Clerks and stenographers: Harriet M. Cobb, Alice M. Howard.

This department of the experiment station conducts experiments in animal nutrition and applies the science of chemistry in studying dairy problems, the composition of soils and the composition and food requirements of plants and animals. It inspects the fertilizers and cattle feeds sold in the State, as well as Babcock machines and the accessory apparatus employed in determining the commercial value of milk and cream; tests water used for drinking, at a cost of $3 per sample; analyzes farmers' samples of fertilizer, milk and cream free of cost, and conducts tests of pure-bred cows under the rules and regulations of the several cattle clubs. Its work for the year ending Dec. 1, 1908, is outlined below.

1. Correspondence.

The department conducts correspondence with interested parties on all of the subjects mentioned above, endeavoring so far as possible to answer all questions promptly and completely. The number of letters of all kinds sent out during the year has approximated 4,800.

2. Numerical Summary of Laboratory Work.

From Dec. 1, 1907, to Dec. 1, 1908, there have been received and examined 143 samples of water, 625 of milk, 2,899 of cream, 122 of feed stuffs, 169 of fertilizers and fertilizer materials, 33 soils and 26 miscellaneous. In connection with experiments made by this and other departments of the station there have been examined 256 samples of milk, 194 samples of skim milk and buttermilk, 54 samples of butter, 151 samples of cattle feeds and 476 samples of agricultural plants. There have also been collected and examined 895 samples of cattle feeds in accordance with the requirements of the feed law, and 624 samples of fertilizer in accordance with the fertilizer law. The total for the year has been 6,667.

In addition to the above, 23 candidates have been examined and given certificates to operate Babcock machines, and 2,713 pieces of Babcock glassware have been tested for accuracy of graduation, of which 33, or 1.22 per cent., were inaccurate.

3. Report of the Fertilizer Division.

Mr. Henri D. Haskins makes the following report, including topics (*a*) through (*j*): —

The principal work of the fertilizer division has been in connection with the official inspection of commercial fertilizers and the analyses of materials forwarded by farmers and farmer organizations.

The new law, obliging the station to publish commercial valuations and the percentage of differences, has added materially to the detail of the inspection work, more particularly with reference to the necessary correspondence and clerical work. The results of the year's work indicate a more complete collection and analyses of the licensed brands than ever before, and show, on the whole, an improvement over the preceding year in the quality of the goods that have been sold in Massachusetts markets.

(*a*) *Fertilizers licensed.*

During the year 76 manufacturers, importers and dealers have secured licenses for the sale of 409 distinct brands of fertilizers and agricultural chemicals in Massachusetts; this is

23 more than were licensed in 1907. They may be grouped as follows: —

Complete fertilizers,	306
Fertilizers furnishing potash and phosphoric acid,	8
Ground bone, tankage and dry ground fish,	40
Agricultural chemicals,	55

(*b*) *Fertilizers collected.*

The samples which furnished the material for this year's inspection were taken by Mr. W. K. Hepburn, the authorized sampling agent of the experiment station. During the months of April, May and June, 624 samples, representing 400 distinct brands, were taken from dealers' stock in various parts of the State. Ninety towns were visited and samples were taken from about 180 different agents. Duplicate samples of the same brand have been taken from various parts of the State whenever possible, as in previous years, and an analysis has been made of a composite sample composed of equal weights of the various samples.

(*c*) *Fertilizers analyzed.*

Ninety-two more analyses have been made than during the previous year. One hundred and eleven more samples, representing 44 more brands, have been collected and analyzed than during 1907. In the inspection of the licensed fertilizers the following analyses have been made: —

Complete fertilizers,	322
Ground bone, tankage and fish,	39
Acid phosphate, dissolved bone black and slag,	14
Cotton-seed meal, linseed meal, castor pomace, blood and nitrate of soda,	26
Muriate, sulfate and carbonate of potash and kainit,	24
Materials furnishing potash, phosphoric acid and lime, such as ashes,	8

Aside from this, 21 samples of fertilizer have been analyzed that were sampled officially by the collecting agent and which represent goods manufactured for private use, making in all 454 analyses.

(*d*) *Trade Values of Fertilizing Ingredients.*

	Cents per Pound.
Nitrogen: —	
In ammonia salts,	17½
In nitrates,	18½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	20½
Organic nitrogen in fine[1] bone and tankage,	20½
Organic nitrogen in coarse[1] bone and tankage,	15
Phosphoric acid: —	
Soluble in water,	5
Soluble in ammonium citrate (reverted phosphoric acid),	4½
Soluble in fine[1] ground bone and tankage,	4
Soluble in coarse[1] bone and tankage,	3
Soluble in cotton-seed meal, linseed meal, castor pomace and ashes,	4
Insoluble (in neutral citrate of ammonia solution) in mixed fertilizers,	2
Potash: —	
As sulfate, free from chlorides,	5
As muriate (chloride),	4¼
As carbonate,	8

The above trade values of fertilizing ingredients in raw materials and chemicals are the same as for the previous year, and represent the values agreed upon by representatives of the experiment stations in New England and the Middle States, after a careful study of prevailing prices in the large cities in these localities.

The average comparative commercial value of the complete fertilizers analyzed during the season of 1908 is $25.81, the retail cash price per ton $36.20, and the percentage of difference 40.25.

[1] Fine and medium bone are separated by a sieve having circular openings one fiftieth of an inch in diameter, the valuation being based upon the degree of fineness.

(e) Guarantees and Analyses compared.

Manufacturer.	Number Brands analyzed.	Number with Three Elements equal to Guarantee.	Number equal to Guarantee in Commercial Value.	Number with One Element below Guarantee.	Number with Two Elements below Guarantee.	Number with Three Elements below Guarantee.
W. H. Abbott,	2	1	2	1	–	–
American Agricultural Chemical Company,	76	51	75	22	2	1
Armour Fertilizer Works,	10	7	10	3	–	–
Beach Soap Company,	3	3	3	–	–	–
Berkshire Fertilizer Company,	5	3	5	2	–	–
Bonora Chemical Company,	1	1	1	–	–	–
Bowker Fertilizer Company,	29	17	27	10	2	–
Joseph Breck & Sons,	3	2	2	1	–	–
Buffalo Fertilizer Company,	7	3	6	4	–	–
Coe-Mortimer Company,	8	5	8	2	1	–
Eastern Chemical Company,	1	1	1	–	–	–
Essex Fertilizer Company,	8	3	8	5	–	–
R. & J. Farquhar & Co.,	5	2	5	3	–	–
Fertilizer Products Company,[1]	1	1	1	–	–	–
C. W. Hastings,	1	–	1	1	–	–
Lister's Agricultural Chemical Works,	7	4	6	2	1	–
J. E. McGovern,	1	1	1	–	–	–
Mapes Formula and Peruvian Guano Company.	17	10	14	7	–	–
National Fertilizer Company,	13	11	13	2	–	–
National Guano Company,	1	–	–	1	–	–
New England Fertilizer Company,	6	5	5	1	–	–
Northwestern Fertilizer Company,	1	–	1	1	–	–
Olds & Whipple,	6	3	6	2	1	–
Parmenter & Polsey,	4	2	2	1	1	–
R. T. Prentiss,	3	1	3	2	–	–
Pulverized Manure Company,	1	1	1	–	–	–
W. W. Rawson & Co.,	3	1	3	2	–	–
Rogers Manufacturing Company,	8	2	8	6	–	–
Rogers & Hubbard Company,	7	6	7	1	–	–
Ross Brothers Company,	1	–	–	1	–	–
N. Roy & Son,	1	–	–	–	1	–
Sanderson Fertilizer and Chemical Company.	8	5	6	1	1	1
M. L. Shoemaker & Co., Limited,	2	2	2	–	–	–
Smith Agricultural Chemical Company,	7	5	7	2	–	–
Swift's Lowell Fertilizer Company,	12	5	12	7	–	–
Whitman & Pratt Rendering Company,	4	3	4	1	–	–
Wilcox Fertilizer Works,	5	4	5	1	–	–
A. H. Wood & Co.,	1	1	1	–	–	–
Wunsch Manufacturing Company,	3	2	3	1	–	–

A study of the preceding table, showing a summary of the results of the inspection of complete fertilizers, reveals the fact that out of the 282 distinct brands analyzed, 110, or about 39 per cent, of the whole number, fell below the manufacturers' guarantee in one or more elements. Ninety-eight were deficient in one, 10 in two and 2 in all three elements. Twenty-nine brands were deficient in nitrogen, 57 in potash and 38 in phosphoric acid. The deficiencies in many of these brands were made up by an excess of some of the other elements, so that only 17 out of the 282 brands analyzed showed a commercial shortage.

[1] Ellis Chalmers Company (successors).

This shortage ranged from a few cents to $3.36 per ton; only 8 brands showed a commercial shortage of over $1 per ton.

The following table shows a comparison between the commercial shortages found during 1908 and 1907: —

Commercial Shortage.	Number of Brands.	
	1908.	1907.
Between $1 and $2,	7	11
Between $2 and $3,	1	6
Between $3 and $4,	3	–
Between $4 and $8,	–	6

The above certainly shows an improvement this year over conditions which existed during 1907.

(*f*) *High-grade v. Low-grade Fertilizers.*

It is gratifying to note the large proportion of high-grade as compared with the medium and low-grade fertilizers that are being sold in Massachusetts. One hundred and fifty-one out of a total of 282, or 53.55 per cent, of the complete fertilizers sold, have a value of over $24 per ton. Some interesting information is brought out by comparing the quantity and value of plant food furnished by three grades of mixed fertilizer. The 282 brands analyzed may be grouped as follows: —

Brands valuing $18 per ton or less (low grade),	26
Brands valuing between $18 and $24 per ton (medium grade),	105
Brands valuing over $24 per ton (high grade),	151
Total,	282

Grade.	Number of Brands.	Per Cent. of Whole.	Average Composition.				Average Valuation.	Average Cost.	Excess of Selling Price over Valuation.	Percentage Difference.
			Per Cent. Nitrogen.	Per Cent. Available Phosphoric Acid.	Per Cent. Potash.	Pounds Available Plant Food in 100 pounds Fertilizer.				
Low grade,	26	9.22	1.74	6.90	2.22	10.86	16.06	28.48	12.42	77.33
Medium grade,	105	37.23	2.42	8.02	3.73	14.17	20.93	31.13	10.20	49.16
High grade,	151	53.55	4.06	7.65	7.44	19.15	30.51	40.96	10.45	34.25

It is apparent from the above table that with less than a 44 per cent advance in price over the low-grade fertilizer, the high grade furnishes more than 75 per cent increase in available plant food and nearly 90 per cent increase in commercial value. A ton of the high-grade fertilizer furnishes about 46 pounds more of nitrogen, 15 pounds more of available phosphoric acid and 104 pounds more of potash than do the low-grade goods. The high-grade fertilizers, with a 31.6 per cent advance in price over the medium grade, furnish 35 per cent more plant food with about 46 per cent increase in commercial value. The medium-grade goods also furnish much better value for the money invested than do the low-grade fertilizers. The medium grade, costing 9 per cent more than the low-grade fertilizers, furnish 30.5 per cent more plant food and have about 30.5 per cent greater commercial value. The consumer purchasing the low-grade fertilizers has paid, on the average, 8.83 cents per pound more for nitrogen, over 2 cents per pound more for available phosphoric acid and 2.15 cents per pound more for potash than has the user of the high-grade fertilizers. The purchaser of the medium-grade goods has paid, on the average, 3 cents more per pound for his nitrogen and three-fourths of a cent per pound more for his available phosphoric acid and potash than has the purchaser of the high grade goods. These figures speak for themselves.

(*g*) *Quality and Commercial Cost of Bone, Tankage and Fish.*

Out of the 34 samples of ground bone, tankage and dry ground fish, 5 showed a deficiency in nitrogen and 6 in phosphoric acid; only 1 of these brands, however, showed a commercial shortage.

The average retail cash prices, valuations and percentages of difference of the ground bone, dissolved bone, tankage and dry ground fish are as follows: —

	Average Retail Cash Price.	Commercial Valuation.	Percentage Difference.
Ground bone,	$30.08	$29.09	3.40
Dissolved bone,	29.33	27.08	8.31
Tankage,	27.50	31.66	13.14 [1]
Dry ground fish,	39.00	40.63	4.01 [1]

[1] In excess of selling price.

(h) *Quality of Other Raw Materials.*

In the chemicals and raw materials furnishing nitrogen, only 1 sample of cotton-seed meal failed to meet the guarantee in this element. Three samples of dissolved bone black and 2 samples of acid phosphate failed to meet the guarantee in available phosphoric acid. Among the potash compounds 1 sample of high-grade sulfate, 5 of muriate and 1 of carbonate failed to meet the potash guarantee.

(i) *Cost of Plant Food in Raw Materials.*

The various agricultural chemicals and raw materials, as *sold at retail in our local markets,* have furnished nitrogen, phosphoric acid and potash to the consumer at the following prices: —

	Cents per Pound.
Nitrogen: —	
From nitrate of soda,	18.40
From blood,	20.50
From cotton-seed meal,	22.05
From linseed meal,	26.70
From castor pomace,	22.40
Available phosphoric acid: —	
From dissolved bone black,	7.80
From acid phosphate (superphosphate),	5.90
Potash: —	
From carbonate of potash,	8.00
From high-grade sulfate of potash,	5.00
From potash-magnesia sulfate,	5.70
From muriate of potash,	4.50
From kainit,	5.11

(j) *Miscellaneous Fertilizers, Soils and By-products for Free Analysis.*

During the past year 169 samples of fertilizer and by-products used for fertilizer, 33 samples of soil and 11 samples of miscellaneous materials have been analyzed for farmers and others interested in agriculture. Comparative valuations, with advice as to the best method of using these materials, have been furnished the applicant at the time the results of analyses were reported. We have every reason to believe that the samples

forwarded have been representative in each instance, as they were invariably taken according to instructions forwarded from this office. The above analyses have not been published in our fertilizer bulletin.

Aside from the above, an active part has been taken in the work of the Association of Official Agricultural Chemists. The writer has acted in the capacity of referee on inorganic plant constituents, planning and compiling the work for this section of the association as well as executing the detailed work as a co-operator.

Eighteen complete soil analyses have also been made in connection with field experiments conducted by the agricultural department of the station.

4. Report of the Feed and Dairy Division.

Mr. P. H. Smith, in charge of the division, reports as follows, including topics (*a*) through (*h*): —

(*a*) *Execution of the Feed Law.* (*Acts of 1903, Chapter 122.*)

The feed law now in force in this State went into effect July 1, 1903. Its purpose is to so regulate the sale of commercial concentrated feed stuffs as to enable the consumer to purchase with a full understanding of what he is buying. Briefly stated, the law requires that every lot or parcel of concentrated feed offered or exposed for sale shall bear a statement giving the name and address of manufacturer, net weight and guarantee of protein and fat. The wheat by-products and the cereal grains, ground or unground, are exempt from the provisions of this act. Any adulterated feed must bear a statement of its true composition. An inspector is kept on the road during a considerable part of the year, who collects samples of the feeds offered for sale and reports any violations of the law. The director of the experiment station or his deputy is authorized to carry out the provisions of the act and to publish such results as are of value.

There have been collected by the inspector during the past year 895 samples of feed stuffs which were found offered for sale in the Massachusetts markets. As it is only possible for

the experiment station to issue one feed bulletin yearly, the results of the examination of those feeds collected during the winter and early spring were not published in bulletin form. In every case, however, the analyses were sent to the manufacturers, and in case of misrepresentation or failure to meet the guarantee, attention was especially called to these points. All of these feeds were practically as represented. When results are of sufficient importance, it is the intent of the experiment station to keep the public fully informed by means of circulars, newspaper articles and correspondence, as well as by the regular annual feed bulletin.

During the season of 1906–07, the cotton-seed meal found on the northern market varied greatly in composition and much of the meal offered fell decidedly below its guarantee. This situation has been greatly improved, and for the season just past practically all of the cotton-seed meal found has been of good quality.

In general it may be said that there have been few violations of the feed law. Occasionally dealers neglect to mark material of good quality with guarantee tags, as required by statute. No new types of feed have been found during the last twelve months, although many new brands of existing types are freely offered. For a full description of the results of the feed inspection the interested reader is referred to the special feed bulletins.

(*b*) *Execution of the Dairy Law. (Acts of 1901, Chapter 202.)*

The purpose of the dairy law is to insure accuracy in the manipulation of the Babcock test where used in fixing the value of milk or cream, either in buying or selling. The work required by this act is subdivided into three natural divisions: (1) the examination of candidates, (2) the testing of glassware and (3) the inspection of machines.

Examination of Candidates. — During the past year 23 examinations have been given and certificates issued for proficiency in Babcock testing. Several candidates have been refused certificates, chiefly on account of not being sufficiently familiar with all phases of the work. If it happens that an

operator is proficient in testing whole milk, it does not necessarily follow that the experiment station is justified in giving him a certificate until he has shown the requisite skill in the whole field. It is obvious that a tester may pass a perfectly satisfactory examination and yet employ careless and slovenly methods in practice. The writer wishes to re-emphasize the point made by the head of the department in the last annual report, "that the present law should be so amended as to give the experiment station the privilege of revoking the license of all operators who employ dirty glassware and who are not conscientiously performing their duties."

Testing Glassware. — All Babcock glassware intended for use where the Babcock test is a basis for fixing the value of milk and cream must be tested for accuracy and marked "Mass. Ex. Sta.," to signify that it has been so tested and found correct. During the past year 2,713 pieces of glassware were examined, and only 1.22 per cent were found incorrect, an improvement of 5.4 per cent over the previous year.

Annual Inspection of Babcock Machines. — This inspection was made in November, 1908. Of the 31 places visited, 19 were creameries, 10 milk depots, 1 city milk inspector and one a chemical laboratory. Thirteen of the creameries were co-operative and 6 were proprietary. The 10 milk depots were, in every case, proprietary. Thirty-one machines were inspected, of which 2 were condemned. As a whole, the machines were in good condition. Those in use are 13 Facile, 5 Argos, 6 Wizard, 3 electrical and 4 Stoddard. The glassware, as a whole, was clean, but a few still use very dirty bottles. In one case the pipettes were not tested. The creameries and milk depots in operation that pay by the Babcock test are as follows: —

1. *Creameries.*

Location.	Name.	President or Manager.
1. Ashfield, ...	Ashfield Co-operative, .	Wm. Hunter, manager.
2. Belchertown, . . .	Belchertown Co-operative, .	M. G. Ward, president.
3. Brimfield, ...	F. N. Lawrence, . . .	F. N. Lawrence, proprietor.
4. Cheshire, ...	Greylock Co-operative, .	C. J. Fales, president.
5. Cummington, . . .	Cummington Co operative, .	W. E. Partridge, manager.
6. Egremont, . . .	Co operative, . . .	E. A. Tyrrell, manager.
7. Easthampton, . . .	Hampton Co-operative, .	W. H. Wright, superintendent.
8. Heath, ...	Cold Spring, . . .	F. E. Stetson, manager.
9. Hinsdale, ...	Hinsdale Creamery Company.	W. C. Solomon, proprietor.
10. Monterey, ...	Berkshire Co-operative, .	F. A. Campbell, manager.
11. New Salem, . . .	New Salem Co-operative, .	W. A. Moore, president.
12. North Brookfield, . .	North Brookfield, . .	H. A. Richardson, proprietor.
13. Northfield, . . .	Northfield Co-operative, .	L. R. Smith, superintendent.
14. Shelburne, . . .	Shelburne Co-operative, .	Ira Barnard, manager.
15. Shelburne Falls, . .	Shelburne Falls, . . .	T. M. Totman, proprietor.
16. Springfield, . . .	Tait Brothers, . . .	Tait Brothers, proprietors.
17. Westfield, P. O. Wyben Springs.	Wyben Springs Co-operative.	C. H. Wolcott, manager.
18. Williamsburg, . . .	Williamsburg, . . .	D. T. Clark, manager.
19. Worthington, P. O. Ringville.	Worthington Co-operative, .	M. R. Bates, superintendent.

2. *Milk Depots.*

Location.	Name.	President or Manager.
1. Boston, P. O. Charlestown.	D. W. Whiting & Sons, .	George Whiting, manager.
2. Boston, P. O. Charlestown.	H. P. Hood & Sons, . .	Wm. Brown, manager.
3. Boston, ...	Boston Dairy Company, .	W. A. Graustein, president.
4. Boston, ...	Walker-Gordon Laboratory,	Merrill B. Small, manager.
5. Boston, P. O. Roxbury, .	Alden Brothers, . . .	Alden Brothers, proprietors.
6. Cambridge, . . .	C. Brigham Company, .	J. R. Blair, manager.
7. Cheshire, ...	Ormsby Farms, . . .	E. B. Penniman, proprietor.
8. Dorchester, . . .	Elm Farm Milk Company, .	J. H. Knapp, manager.
9. Sheffield, ...	Willow Brook Dairy, . .	G. W. Patterson, manager.
10. Southborough, . . .	Deerfoot Farm, . . .	S. H. Howes, manager.
11. Springfield, . . .	Emerson Laboratory, . .	H. C. Emerson, proprietor.
12. Springfield, . . .	Milk inspector, . . .	Stephen C. Downs.

(c) *Milk, Cream and Feeds sent for Free Examination.*

The experiment station has in the past analyzed and will continue in the future to analyze samples of milk, cream and feeds sent for examination, in so far as the time and resources at its command will allow. Only in exceptional cases should material intended for free chemical examination be sent to the experiment station, except by previous arrangement. Upon application full instructions for sampling and directions for shipping will be furnished.

(d) *Sanitary Analysis of Drinking Water.*

During the year ending Dec. 1, 1908, there have been examined 143 samples of water. The cost of an analysis is $3, which must be forwarded in advance and the express charges on the sample prepaid. In order to secure an analysis, application must be made, whereupon a suitably encased glass jar, together with full instructions for gathering and shipping, are forwarded by express. An analysis of water sent in shipper's jar will not be made, neither will a bacteriological nor mineral analysis be undertaken. The station does not examine water to determine its fitness for manufacturing purposes, it being held that this is the legitimate work of the commercial chemist. The object of the station in making an examination of water is to enable citizens of the State depending upon wells and springs to ascertain, at a minimum expense, whether their supply is free from objectionable matter, which is likely to gain access to it from sink, privy or barn drainage. Such an examination is referred to as a sanitary analysis. Those who are dependent upon local wells and springs are frequently very careless in the care of the same. As a result the water becomes polluted, and serious sickness is likely to follow. After the soil has once become contaminated it requires considerable time to purify itself, and the water is often rendered unfit for use for a number of years. Farmers and others are strongly urged to guard the well and spring from all possible bad drainage. Sink drainage should be conducted at least 100 feet or more away from the well and properly cared for, privy vaults should be located a similar distance and be frequently cleaned

and made water tight. Barns should not be located near wells or springs when the water is to be used for either human or animal consumption.

Lead pipe should never be employed for conducting drinking water; in case it is in use its removal is urged and iron pipe coated with asphaltum or galvanized iron pipe substituted. *Lead is a poison,* and if it once gains access to the system it is difficult to eliminate. The station frequently finds lead in drinking water when lead pipe is used, and cases of lead poisoning are of common occurrence. Beware of lead pipe!

(*e*) *Miscellaneous.*

This division has co-operated with the Association of Official Agricultural Chemists in a study of methods for the determination of the various ingredients in condensed milk. The results have been reported to the association.

(*f*) *Testing of Pure-bred Cows.*

The experiment station continues its work of testing pure-bred cows for the various pure-bred cattle associations. This work is often confused with the work of cow-testing associations. The work is entirely different, in that pure-bred cows are tested under the rules of their respective associations, while the cow-testing association is purely local, and may include any or all breeds. One man is employed practically all of the time in connection with the Guernsey, Jersey and Ayrshire tests, which usually run for one year, it being necessary for the supervisor to visit the farms where the animals are on test once each month. The Holstein tests are of much shorter duration, usually from seven to thirty consecutive days, and require the presence of the supervisor during the entire test. For this work it is necessary to depend on men who cannot be regularly employed. Such men are difficult to obtain, and there is at times considerable trouble in obtaining men to fill all applications.

During the past year 20 yearly Guernsey, 5 seven-day and 56 yearly Jersey tests have been completed. For the Holstein-Friesian Association 63 seven-day, 5 fourteen-day, 10 thirty-day and 1 forty-four day tests have been completed. There are

now on test for yearly records 54 Jerseys, 21 Guernseys and 6 Ayrshires. It is believed that the semi-official yearly tests would give a much better indication of the true productive capacity of an animal than tests of shorter duration.

5. Special Chemical Work.

Work in the laboratory has also been carried out on the chemical composition of soils, butter fat and insecticides, and is being continued at the present time. This work forms a part of various investigations which are in progress, and it is not considered necessary to more than mention it in this connection.

REPORT OF THE BOTANIST.

G. E. STONE.

The work of this department during the past year has consisted in the usual routine work, correspondence, seed testing and research work dependent upon some phase of pathology and physiology. The laboratory work has been carried on by Mr. George H. Chapman, with occasional aid from students and recent graduates, and Miss J. V. Crocker, besides attending to other duties, has had practically entire charge of the seed testing.

During the past year a conservatory, 28 by 70 feet, divided into compartments, with a lean-to and a propagating pit, has been added to Clark Hall. A part of this will be used for various experiments with market-garden and florist's crops during the coming year.

The past summer and fall have been unusually dry and have proved to be very severe for vegetation. Many public reservoirs have been unusually low, and wells which have never been known to fail in their supply of water have been completely dry this fall; in fact, the drought has been the worst known for many years. The season preceding this was also exceptionally dry, although followed by much rain in the fall; and the winter following was responsible for some winter-killing of peach tree roots.

This year's drought affected potatoes severely, causing much sun scald of the foliage, and was responsible for a small yield. The results of good feeding, tillage and spraying, however, were noticeable on the yield. There was very little blight of potatoes due to fungi, although here and there might be found evidence of the early blight and *Cladosporium,* which is seldom troublesome to potatoes. The potato mildew (late blight) and rot were not common.

Some trouble was experienced with tulip bulbs, but there seemed to be no infection, and the trouble was apparently associated with a poor grade of bulbs on the market this season. The peach leaf curl was more or less abundant in the spring, and much complaint was also received in regard to sweet peas. The diseases affecting sweet peas are obscure and need investigation. There was considerable mildew on phlox, which was in some cases associated with other difficulties, the cause of which is not as yet clearly established. A few cases of strawberry winter-killing were observed; these may have been associated in some cases with a bacterial trouble. Specimens of blackberries and raspberries were sent in which showed cane blight. Crown gall was reported on the peach and Carolina poplar, and we received specimens of the latter affected with *Didymosphæria populina,* Vuill. Some diseased specimens of *Shortia galacifolia* were sent in affected with a fungus, probably a *Glœosporium.* The Baldwin fruit spot was quite common in the fall; this seems to be more abundant in dry seasons. A serious *Macrosporium* disease of the spinach was also found to be doing severe damage to the crop of one of our large market gardeners.

Our attention was called at different times to the bacterial blight and the downy mildew of cucumbers under glass. These occur when the plants are set in August, but not if set later. Among amateur growers of greenhouse products the misuse of fertilizers is on the increase, and many troubles result from applying fertilizers to soil already well provided with plant foods. Many onion fields suffered severely from sun scald, which in some cases was associated with thrips and in others not. Corn smut, which is generally of minor importance with us, was unusually abundant this year, the dry weather apparently favoring it, and the apple rust, which is seldom seen in Massachusetts, was common, although it caused little damage.

The burning of the white pine was much less severe than during the preceding summer. Most of the burning which did occur took place on the young buds in the spring, and as they developed these brown areas might be noticed on the tips. The usual fungi frequently found on the leaves were present, but no instances of infection were observed. Frequent examination of

the pine roots showed the results of the former winter-killing, but a decided improvement of the new feeding roots was noticed. The severe burning of the pitch pine, noticeable in some localities, is associated largely, if not wholly, with insect work.

Shade and forest trees have had much to contend with in recent years owing to severe drought and other factors, and some of our finest specimens of maples, elms, ash and other specimens have been slowly dying for some years. A peculiar trouble of the elm and sycamore has been brought to our attention many times the past few years; that is, the loss of the outer bark. This trouble has been noted in other States, and in one city which was visited by us a large number of trees in this condition was found. In some instances the injury had extended to the wood, large areas of the bark having died back to the wood, but in most cases the trouble is confined to the outer bark. In such instances no permanent damage will result. This injury dates back to the cold winter of four or five years ago. Some large sycamore trees shed their outer bark to the ground, causing much concern to those who prize them highly as shade trees.

Much premature defoliation and sun scald have occurred during the past two summers, but this sun scald has not been confined to city and village trees. It is often seen on trees growing in their native habitat.

Seed Work.

There has been an increase in the seed work of the past year, samples for germination tests having been received from many more growers than ever before. Eight hundred ninety-eight pounds more seed were separated than in the year 1907. By the aid of the new methods and improved apparatus which have been adopted the work was done with greater facility than has before been possible.

During the past year attention has been given to the further development of apparatus for the separation of seed. One of the worst contaminated seeds which the farmer has to contend with is grass seed, and at the present time we have no suitable methods for separating certain weed seeds from the grass seed.

In the coming year we expect to give this problem further consideration.

Onion and tobacco seed constitute the bulk of the seed received for separation. Both of these crops are grown extensively in the Connecticut valley. The object of separation is, of course, to discard the small seed and chaff, leaving only the large and heavy seed for planting. The percentage of the seed discarded varies somewhat. This would naturally be expected, as the seed comes from different dealers and varies in size and quality, although much of the tobacco seed is home grown.

In some of our seed separation work the amount discarded depends upon the percentage of germination of the sample. Certain growers make a practice, before purchasing in bulk, of obtaining samples, which are sent to the experiment station for testing. A certain percentage of the small seed is blown out, and the original sample, as well as the large and small seed are tested for germination. The results are then sent to the grower, and if satisfactory he purchases in bulk and requests that a certain percentage be blown out.

Small seeds, like tobacco, which are received in small quantities, are separated in glass tubes with bulbs of a special form, and in this form of separation, which is fully described in Bulletin No. 121 of this station, we make use of fifteen pounds' air pressure. The larger seeds, like onion, are separated by a special winnowing machine, given a constant speed by an electric motor. The machine is so arranged that a bushel or more may be separated at one time.

Careful germination tests were made again this year to prove the value of seed separation, and experiments in planting the different grades of separated seed were also made in co-operation with growers in different parts of the State.

The following tables give an outline of the seed work which has been done the past year: —

TABLE 1. — *Records of Seed Germination, 1908.*

Kind of Seed.	Number of Samples.	Germination. Average Per Cent.	Highest Per Cent.	Lowest Per Cent.
Onion,	65	74.2	98.5	-
Tobacco,	10	78.2	97.0	20
Celery,	24	79.0	98.0	35
Corn,	5	87.9	100.0	60
Lettuce,	7	99.0	100.0	95
Pansy,	50	86.9	100.0	59
Miscellaneous,	35	82.7	100.0	7
	196	–	–	–

TABLE 2. — *Records of Seed Separation, 1908.*

Kind of Seed.	Number of Samples.	Weight in Pounds.	Per Cent of Good Seed.	Per Cent of Discarded Seed.
Onion,	57	722.65	86.2	13.8
Tobacco,	84	56.43	86.0	14.0
Celery,	16	551.45	93.7	6.3
Lettuce and parsnip,	3	40.00	90.0	10.0
	160	1370.53	–	–

The average germination of the onion seed for 1908 is not as high as for either of the two preceding years, some very poor seed having been received. Onion seed was occasionally brought in for testing which had been left over from previous years and was too old for use. The corn and lettuce seeds received were remarkably good samples, six lots of the lettuce seed giving 100 per cent. of germination, — a very unusual percentage.

Only 2.5 per cent. was discarded from the best sample of onion seed, 4.6 from the best tobacco seed and 9.3 per cent. from the best celery seed. From the poorest onion seed 29.7 per cent. was discarded, 26.9 per cent. from the poorest tobacco and 33⅓ per cent. from some of the celery seed. The large percentage discarded, however, does not in all cases imply that the seeds were poor: on the other hand, as much as 33⅓ per cent. was frequently discarded purposely, especially when the seed was to be used for experimental purposes, which was the case

with the celery. The average percentage of germination shown is good when one considers the large amount of poor seed which is yearly placed on the market.

Farmers who use large quantities of seed are naturally more particular about its quality than those who purchase small quantities. Tobacco and onion growers and market gardeners may be considered specialists, and the quality and source of the seed which they purchase are important items with them, making it a matter of good business to obtain the best seed from the most reliable firms. Since practically all tobacco men grow their own seed they have an opportunity to exercise great care in the selection of their seed plants, and onion growers purchase from reliable dealers; but the general farmer and the individual who plants only his vegetable and flower garden need only small quantities of seed, and often purchase the so-called "packets" (commission seed) from the local dealer. These seeds are often not true to name and are too frequently worthless as regards quality.

Mr. Edgar Brown[1] in charge of the United States Department of Agriculture Seed Laboratory, found that the average germination of 2,778 packets, including 26 kinds from 27 seed-packeting houses, was only 62.2 per cent.

The average germination of seeds from one firm was only 37.3 per cent., and from another 44.3 per cent.

The variation in germination of different packets of the same kind of seed from the same firm was in several cases more than 90 per cent.

By 21 of the 27 seedsmen whose seed was tested, 200 lots of seed were put up which germinated 10 per cent. or less.

By 13 packeting houses 62 lots of seed were put up which entirely failed to germinate.

The average germination of the "commission" seeds tested was 25.7 per cent. lower than that of those sent out in the congressional seed distribution during the past six years.

It is quite evident from the results of Mr. Brown's investigations on seeds — and there is no reason to believe that the results are different than would be obtained from any testing — that we are sadly in need of seed legislation. However, the large dealers in seeds who sell direct to the consumer are not,

[1] Bulletin No. 131, Bureau Plant Industry, United States Department Agriculture, 1908.

as a rule, unscrupulous, most of them testing their own seed, as they do not care to injure their business by unloading on the public seeds which are worthless. They do not, however, as a rule, guarantee purity or the percentage of germination.

Twelve purity tests of clover, alfalfa and mixed grass seed were made, the highest percentage being 99.4, the lowest 85.3. The impurities found in our seeds are largely weed seeds of a noxious nature. One farmer informed us that after seeding down his large piece of land it required considerable time and expense to pull up the dock which had established itself in his field as a result of using seed which contained seeds of this noxious weed. There is constant complaint in regard to the impurity of seeds, and a considerable burden is imposed on the farmer by his being obliged to waste time and money in exterminating the noxious weeds introduced in his grass seed. It should be stated, however, that all weeds found in newly seeded land do not necessarily come in the grass seed. The past summer many lawns planted with the best seed obtainable produced nothing but pigweed, crab grass, etc., for the soil moisture, on account of the drought, has been insufficient to start grass and clover, while it is one of the characteristics of many weeds that they possess a wide range of adaptability, and will survive under conditions which would be disastrous to grass and clover.

Seed to be tested or separated should be sent by mail or express to G. E. Stone, Massachusetts Agricultural Experiment Station. The work is done gratuitously by the station for people living in the State, but the postage or express charges should be paid by the person sending the samples.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD; H. T. FERNALD; J. N. SUMMERS.

During 1908 the entomological work of the experiment station has progressed along the usual lines. The correspondence has been extensive, requiring much time and often a considerable amount of study before all the inquiries received could be satisfactorily answered. The year has been a favorable one for the increase to destructive numbers of many different kinds of pests, and this condition has been reflected in the letters received.

The experimental work of the division has been the continuation of investigations previously begun, these requiring so much time as to practically prevent taking up additional lines of research. Tests of the resistance of muskmelons under glass to the effects of hydrocyanic acid gas have been continued, but have not as yet been completed. A determination of the best methods for the control of the cabbage maggot was started in the spring, but, as was the case the preceding year, almost no maggots appeared either in the experimental portion or elsewhere in the field, so that no results of any great value could be obtained. This, though disappointing, only signifies that the experiments must be continued until the maggots become sufficiently abundant to give real tests as to the value of the different treatments; and as these must be begun before the maggots appear, it is very possible that the work may require repetition for several years before any data can be obtained.

Observations on the dates of the appearance of the young of the more common and injurious scales have also been continued, adding to our knowledge of this subject and making it possible to more nearly set the date limits within which spraying for these insects must be done in order to be effective; but these observations have not thus far covered a sufficiently long term

of years to provide complete data, and they will therefore be continued.

The importance of the second brood of the codling moth in Massachusetts is also still unsettled, though the facts for another year can now be added to those previously collected. This question is an important one, as the answer to it may determine the value of a late treatment for this insect.

The onion thrips was a less serious pest in 1908 than in the preceding year, if conditions in all parts of the onion-growing region be considered, though it was very injurious in some places. This insect, which is widely distributed both in Europe and the United States, is known to feed on about fifty different plants, and was reported by Packard in 1872 as seriously injuring onions in Essex County, Mass., causing a probable loss there that year of $10,000, and as having been known as an onion pest in that region for about fifteen years.

Various methods for the control of this insect in the onion fields have been tested during the past two years, with more or less success, but without entire satisfaction, and it is now the intention to try other measures for its destruction, and extended experiments along these lines will be undertaken during the coming season.

The results of tests of a new material for the San José scale, referred to in the last report, were encouraging and were therefore repeated last spring, but with less success, the material seeming to be different from that previously used. It is probable that farther experiments with this substance will be necessary before its real value can be determined.

The cranberry insect investigations, conducted at Wareham during the summers of 1906 and 1907 by Dr. H. J. Franklin, have resulted in many additions to our knowledge of these pests, and have led to the formulation of numerous recommendations as to methods of treatment. Practical tests of these, repeated for several years, would now be in order, but to make them, entire control of a bog is necessary, and it has thus far proved impossible to obtain a bog for experimental purposes of this kind except on terms which could not be accepted. Under such circumstances it has been impossible to accomplish much during the past summer, and it would seem doubtful if very much more

can be done as long as present conditions remain unchanged. Bulletin No. 126 contains the conclusions drawn from this work thus far.

Studies on the distribution of insect pests in Massachusetts, and of the factors determining this, have been continued since the last report, but the pressure of other work has prevented much progress in this line. It has become evident, however, that in southeastern Massachusetts the climatic conditions are such that many animals and plants can survive the winters there when this would not be possible in most, probably any, other parts of the State. Study of the lines of dispersal of insect pests shows many southern forms spreading to the north and east from their earlier homes, together with a probably gradually increasing power of resistance to low temperatures. This indicates that some, at least, of these insects may be able to live in the southeastern portion of this State if they once reach so far. The reverse condition also holds for northern forms, some of which can undoubtedly live and become injurious in the colder parts of the State. To determine the limits of the possible distribution of these pests is important, as this knowledge will be of much practical utility. It is hoped that more time can be devoted to this subject in the future.

Spraying has been from its very beginning an empirical subject. Many thousands of experiments have been made and the results compared, to learn the causes of success and failure. In spite of this little real progress has resulted in the determination of the fundamental principles, or what might perhaps be termed the science of spraying. Thus far the work has been done wholly with commercial materials varying in composition, both qualitatively and quantitatively, and in most cases with no knowledge of the nature of the variations. The only new line of research taken up by this division during the past year has been on this subject. The plan is to obtain the various stomach poisons in as nearly an absolutely pure condition as possible; to determine their exact composition, qualitatively and quantitatively, and then to test them on foliage of different kinds, under varying conditions of heat, light, temperature, humidity and wind, and to study the results in the hope that by working with materials of unusual purity and known com-

position certainty in results may be obtained; and with these as a basis for comparison, to extend the investigation to the ordinary commercial materials, and ultimately to find an explanation for the diverse and often contradictory results so frequently met with in commercial spraying. In this work the services of the chemical division are necessary in making chemical studies of the different materials; of the entomological division in the preparation and application of these materials, and in the study of the results; and very possibly the botanical division may be called on for assistance in an examination of the effects of these treatments on the plant tissues. The field for experiment in this subject is very large, and at present we have very little accurate, positive knowledge of it. Thus far the work has not progressed sufficiently to give any results, and ten years promises to be too short for its entire completion, but already some significant points have developed which indicate that this investigation will be well worth all the time which it will require.

REPORT OF THE HORTICULTURIST.

DEPARTMENT OF HORTICULTURE.

F. A. WAUGH, HORTICULTURIST; F. C. SEARS, POMOLOGIST; J. K. SHAW, ASSISTANT.

The work of the department of horticulture during the year 1908 has followed the lines already adopted and set forth in former reports. The most important piece of new work undertaken is a series of orchard experiments in South Amherst, in which the pomologist, Professor Sears, co-operates with the director, Professor Brooks.

During the year some changes have been made on the staff. Prof. F. C. Sears has been added as pomologist, and Prof. E. A. White has been temporarily detached from service as florist. Mr. C. S. Pomeroy resigned September 1 to take up work with the United States Department of Agriculture, and his place was filled by the appointment of Mr. J. K. Shaw, a graduate of University of Vermont and of Massachusetts Agricultural College.

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

At the close of the year the division will have the meteorological records for this station for a period of twenty years. The temperature records for the first year of the period (1889) are not complete, otherwise the records are unbroken.

The policy of the division in general has been to make as few changes as possible in methods of observation or in character of instruments, in order that the comparisons for the different years may be as reliable as is desired.

Five years ago a change was made from tridaily to semidaily observations, so as to conform with the practice of the United States Weather Bureau, — this station having become a voluntary observer of that bureau at about that time. It is not thought that the change has sensibly affected any of the records, so that they may not safely be compared with the records existing before the change was made.

An electric sunshine recorder was installed about two years later, which increased the precision of the sunshine records without materially affecting the mean values.

During the past year the work has continued along the same lines as heretofore, — instrument readings taken at 8 A.M. and 8 P.M., self-recording instruments kept in working order, and the records transcribed weekly in a permanent record book.

The usual monthly bulletins, containing the more important daily records and remarks on the general character of the weather during the month, have been regularly issued, and the annual summary will form a part of the December bulletin.

The New England section of the United States Weather Bureau has furnished us daily, except Sunday, with the forecasts for this section of the State, and the flags indicating the probable weather for the following day have been regularly

displayed from the flagstaff over the tower. The flags are five in number, namely, a white flag, indicating fair weather; blue and white, indicating local showers; blue, indicating rain or snow; white with black center, indicating a cold wave or a drop of more than 20° in temperature for the next day, or the first frost of the season. The first three read downward on the staff. When any of them are displayed together, as white above blue, it means fair followed by rain or snow. A triangular black flag is the temperature flag, which displayed above the others indicates rising temperature or warmer, and displayed below the others falling temperature or colder. The cold-wave flag is never displayed with any of the other flags.

The usual weekly snow reports are being sent to the Boston office this season as heretofore and the voluntary observer's reports are sent there monthly.

A summary of the twenty years' records is nearly complete and will be ready for publication soon after the close of the year. I would recommend that it be published as a part of this report.

EFFECT OF SOY BEAN MEAL AND SOY BEAN OIL UPON THE COMPOSITION OF MILK AND BUTTER FAT, AND UPON THE CONSISTENCY OR BODY OF BUTTER.

BY J. B. LINDSEY, E. B. HOLLAND AND P. H. SMITH.

EXPERIMENT IX.

This experiment is the continuation of a series designed to study the effect of different foods and food groups upon the character and composition of the product of the dairy cow.

Object of the Experiment.

The object of the experiment about to be described was to determine the effect of soy bean meal with a minimum percentage of oil and of the soy bean oil (*a*) upon the proportions of the several milk ingredients; (*b*) upon the chemical character of the milk fat; and (*c*) upon the consistency or body of the butter. It was desired, further, to observe the effect of both the beans minus the oil and of the oil itself upon the separation of the fat from the milk serum, time of ripening of the cream and the thoroughness of the churning process. The present investigation, then, may be spoken of as a study in milk secretion to note the effect specific foods and food groups have in modifying the character of the milk product. Studies of the effect of different food groups upon the percentage composition of the milk, and upon the chemical character of the butter fat, have been made by other investigators. It is not intended, at this time, to review the work of others. References, however, will be made to it whenever the circumstances seem to require.

Plan of the Experiment.

Twelve cows were divided into two lots of 6 each, to be known as herds I. and II. During the first period of four weeks (the first two preliminary) both herds received the same

ration, which is spoken of as the normal ration. During the next period Herd I. continued to receive the normal ration, and Herd II. received an addition of soy beans minus oil, which replaced a like amount of the normal grain ration. During the third period Herd I. continued to receive the same ration as in the two preceding periods, and to the ration of Herd II., after it had been brought back to the normal grain ration, was added a definite amount of soy bean oil. This method was followed instead of adding the oil direct to the soy bean meal ration because of the shortage of soy bean meal, and since it was feared that the bean and excess of oil would have too great a laxative effect upon the animals. The method of feeding enabled one to note the direct effect of soy bean meal and the soy bean oil upon the chemical character of the milk and butter fat.

TABLE I. — *Duration of Experiment, 1907.*

Periods.	Character of Rations.	Dates.	Length of Period (Days).
1,	Herd I., normal grain ration,	Jan. 12 through Jan. 25,	14
	Herd II., normal grain ration,	Jan. 12 through Jan. 25,	14
2,	Herd I., normal grain ration,	Feb. 8 through Mar. 8,	28
	Herd II., soy bean (extracted) ration,	Feb. 8 through Mar. 8,	28
3,	Herd I., normal grain ration,	Mar. 30 through Apr. 19,	21
	Herd II., normal ration plus soy bean oil,	Mar. 30 through Apr. 19,	21

TABLE II. — *Data concerning Cows.*

Herd.	Name.	Breed.	Age (Years).	Last Calf dropped.	Approximate Milk Yield, Beginning of Experiment (Pounds).	Cows served.
I.,	Daisy,	Grade Jersey,	8	Aug., 1906,	16–17	Nov. 10, 1906
	May Rio,	Pure Jersey,	4	Aug., 1906,	16–17	Nov. 20, 1906
	May,	Grade Jersey,	10	Sept., 1906,	22–23	– –
	Cecile,	Pure Jersey,	2	Dec., 1906,	22–23	Feb. 11, 1907
	Gladys,	Pure Jersey,	4	Nov., 1906,	21–22	Dec. 31, 1906
	Betty,	Grade Jersey,	3	Dec., 1906,	22–23	Jan. 21, 1907
II.,	Blanche,	Grade Jersey,	11	Sept., 1906,	21–22	– –
	Fancy,	Grade Jersey,	7	Aug., 1906,	18–19	Nov. 20, 1906
	Susie,	Grade Jersey,	2	Mar., 1906,	10–11	Dec. 9, 1906
	Samantha,	Holstein-Jersey,	4	Sept., 1906,	21–22	Nov. 27, 1906
	Maude,	Guernsey-Jersey,	4	Oct., 1906,	11–12	Nov. 28, 1906
	Red II.,	Shorthorn-Jersey,	10	Oct., 1906,	32–33	Jan. 24, 1907

Feeding and Care of the Animals.

The cows were housed in the station barn, especially set apart for feeding experiments. Each animal was kept in a roomy stall, well carded and turned daily into a yard for several hours when the weather conditions permitted. The barn was heated to a temperature of about 50° F., and particular attention was paid to ventilation and the admission of sunlight. The feed was given in two portions daily, and water was kept continually before each animal by means of the Buckley self-watering device.

Weighing.

Each cow was weighed for three consecutive days at the beginning and end of each period, the weighing being done in the afternoon, before feeding.

Character of the Feeds.

The hay was composed largely of Kentucky blue grass with an admixture of some clover, sweet vernal and a little orchard grass. It was cut when in bloom, well cured, and was considered a first-class hay for milk production. Washburn-Crosby's spring bran was used; the oats were bought in one lot and were of extra quality; the corn meal, gluten feed and cotton-seed meal were satisfactory both in appearance and composition. The so-called normal grain ration was composed of the above feed stuffs mixed in the following proportions: 2 pounds bran, 3 pounds ground oats, 1¼ pounds corn meal, 1¼ pounds gluten feed and ½ pound cotton-seed meal. It is not claimed that this ration had any superior advantages over others; it had been found by experience, however, that such a mixture could be fed with comparative safety, and would produce a firm butter, free from any objectionable flavor; it was used, therefore, as a standard for the comparison of other feed stuffs. The soy bean meal was derived from a number of varieties, the medium green and southern yellow predominating. They were shipped to the V. D. Anderson Company of Cleveland, O., and the oil extracted by pressure. The green variety,

according to information from the above firm, furnished 8 per cent. of filtered oil, while the southern variety yielded 11 per cent. The pressed cake from the several varieties was mixed and ground before being fed; the oil from the several containers, which was of a dark brown color, was mixed previous to feeding. According to Lewkowitsch the bulk of the solid fatty acids in the oil consists of palmitic acid and the liquid fatty acids of oleic and linolic acids.[1] Our tests showed it to have a saponification value of 191.95, a Hehner number of 95.31 and an iodine value of 130.77. Its chemical character will be more fully discussed in a separate article.

Sampling the Feeds.

The hay was sampled at the beginning of each period and every two weeks thereafter. This was considered sufficient to furnish reasonably satisfactory information concerning its chemical character. Forkfuls were taken from different parts of the pile, run through a cutter, subsampled, and the reduced sample placed in a large glass-stoppered bottle and taken to the laboratory. A dry matter determination was made immediately and a definite weight of each individual sample composited. The normal grain ration and the soy bean meal were sampled daily into glass-stoppered bottles and dry matter determinations made at the end of the periods. In case of the normal ration, one analysis was made from a mixture of the three different samples.

Sampling the Milk.

The milk of each cow was sampled twice daily for five consecutive days of each week of the trial, and preserved with formalin in tightly corked bottles. The method of sampling consisted in mixing the freshly drawn milk with a perforated tin disk, 8 inches in diameter, fastened to the end of a rod. This disk was drawn slowly up and down through the quantity of milk a number of times, and then a small dipperful was immediately removed.

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[1] Technology of Fats, Oils and Waxes, third edition, Vol. II., p. 506.

Disturbances during the Experiment.

The first period passed with each animal in excellent condition. Ten days previous to the end of the second period, Blanche, of Herd II., produced very soft fæces, although her general health appeared to have been in no way seriously affected. For the remainder of the period her hay was reduced 4 pounds daily and only one-half her usual allowance of grain given. We also endeavored, by the use of tannin and gentian, to correct the trouble, but it manifested itself more or less during the remainder of the experiment. This necessitated a reduced daily hay and grain ration, and the feeding of not over one-third the amount of oil supplied to the other cows. Towards the close of the third period Red II. began to show signs of a disturbed digestion, although she took her regular ration until the end of the period, after which it was necessary to reduce her food supply. It is believed that the oil was responsible for the condition of the latter cow.

Table III. — *Total Feed consumed by Each Cow (Pounds).*

First Period: normal grain ration.

Herd I.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Daisy,	98	–	–	280
May Rio,	98	–	–	238
May,	112	–	–	280
Cecile,	98	–	–	210
Gladys,	112	–	–	252
Betty,	112	–	–	238

Herd II.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Blanche,	112	–	–	322
Fancy,	112	–	–	247
Susie,	70	–	–	196
Samantha,	112	–	–	308
Maude,	84	–	–	252
Red II.,	140	–	–	322

Table III. — *Total Feed consumed by Each Cow (Pounds)* — Con.

Second Period: Herd I., normal grain ration; Herd II., soy bean meal ration.

Herd I.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Daisy,	196	–	–	560
May Rio,	196	–	–	476
May,	224	–	–	560
Cecile,	196	–	–	420
Gladys,	224	–	–	512
Betty,	224	–	–	476

Herd II.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Blanche,	110.5	55	–	626
Fancy,	154.0	70	–	504
Susie,	98.0	42	–	340
Samantha,	140.0	84	–	616
Maude,	112.0	56	–	504
Red II.,	168.0	84	–	644

Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.

Herd I.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Daisy,	150	–	–	420
May Rio,	147	–	–	357
May,	168	–	–	420
Cecile,	147	–	–	315
Gladys,	168	–	–	378
Betty,	168	–	–	357

Herd II.

Name.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
Blanche,	126.0	–	7.00	420
Fancy,	168.0	–	17.50	378
Susie,	105.0	–	10.50	252
Samantha,	168.0	–	17.50	462
Maude,	126.0	–	12.25	378
Red II.,	175.5	–	16.00	459

TABLE IV. — *Average Daily Rations for Each Cow (Pounds).*

Herds.	Normal Grain Ration.	Soy Bean Meal.	Soy Bean Oil.	First Cut Hay.
First period: both herds, normal grain ration.				
Herd I.,	7.5	-	-	17.8
Herd II.,	7.5	-	-	19.6
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.				
Herd I.,	7.5	-	-	17.9
Herd II.,	4.7	2.3	-	19.3
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.				
Herd I.,	7.5	-	-	17.8
Herd II.,	6.9	-	.6	18.6

Table III. shows the total feed consumption of each animal in the two herds. Table IV. shows the average daily consumption of each cow in both herds. In the first period the cows in Herd I. consumed daily from 6 to 8 pounds of grain and those in Herd II. from 5 to 10 pounds, the average being the same in both herds. The cows in Herd II. consumed rather more hay than those in Herd I. In the second period Herd I. continued to consume the same amount of grain as in the first period and substantially the same amount of hay. In the case of Herd II. it became necessary to cut down the amount of grain for two of the cows, so that the daily total average was ½ pound less than in the first period. The soy bean meal replaced the normal ration in amounts varying from 1½ to 3 pounds per diem, with a daily average of 2.3 pounds. The amount of hay was about the same as that consumed in the first period. In the third period Herd I. continued to consume the same kinds and amounts of food as in the previous two periods. With Herd II. the soy bean meal was replaced by an equal amount of the normal grain ration, and to this was added for each cow from .25 to .83 of a pound of soy bean oil, with an average daily consumption of .6 of a pound. This amount of oil did not seem to in any way interfere with the normal

condition of the herd, except in the instance previously noted. The average daily consumption of hay decreased .7 of a pound during this period. It may be stated that the amount of hay and grain fed daily depended partly upon the calculated nutrients needed by the animal and partly upon the animal's individuality. This latter condition can only be ascertained by being in close touch with each cow and by careful observation. If an animal appeared to be having more than she could consume to advantage, or did not eat clean her daily allowance, the ration was reduced in amount.

TABLE V. — *Average Dry Matter and Digestible Nutrients in Ration of Each Cow (Pounds).*

Herds.	Average Weight of Cows (Pounds).	Total Dry Matter.	Digestible Organic Nutrients.			Nutritive Ratio.
			Protein.	Carbo-hydrates.	Fat.	
First period: both herds, normal grain ration.						
Herd I.,	809	22.70	1.91	11.00	.52	1:6.4
Herd II.,	933	24.31	2.01	11.77	.54	1:6.5
Second period: Herd I., normal grain ration: Herd II., soy bean meal ration.						
Herd I.,	828	22.86	1.92	11.01	.52	1:6.3
Herd II.,	948	23.67	2.50	11.15	.60	1:5.0
Third period: Herd I., normal grain ration: Herd II., soy bean oil ration.						
Herd I.,	832	22.63	1.90	10.97	.52	1:6.4
Herd II.,	967	23.41	1.87	11.05	1.11	1:7.2

In the above table is given an estimate of the amount of digestible nutrients contained in the average daily rations. The average weight of the cows in Herd I. varied from 809 to 832 pounds in the several periods, and in Herd II. from 933 to 967 pounds. The method of calculating the digestible nutrients consisted in applying average digestion coefficients to the actual analysis of the hay and soy beans, and to multiplying the product by the average number of pounds fed daily. In case of the normal ration, coefficients were employed that were obtained from the normal or standard grain ration, so-called,

fed in previous experiments of a similar nature.[1] The present normal ration differed, however, somewhat from the former, as will be seen from the following statement: —

Present Normal Ration.	*Earlier Normal Ration.*
2 pounds wheat bran,	3 pounds wheat bran,
3 pounds ground oats,	5 pounds ground oats,
1¼ pounds gluten feed,	½ pound gluten meal,
1¼ pounds corn meal,	½ pound cotton-seed meal.
½ pound cotton-seed meal.	

The digestion coefficients evidently would be somewhat higher for the present normal ration, and hence the total digestible nutrients contained in the present average daily ration would be rather in excess of those given. The data presented, however, are at least comparative; in fact, the exact amount of digestible nutrients contained in the rations has no direct bearing on the objects sought; they simply indicate that the two herds were sufficiently and normally nourished.[2]

In the second period Herd II. consumed about ½ pound more digestible protein than Herd I., due to the presence of the soy bean meal. In the third period Herd II. ate some .6 of a pound more fat (derived from soy bean oil) than did Herd I.

Table VI. — *Average Weight of Each Cow at Beginning and End of Each Period (Pounds).*

First period, Herd I.

	Daisy.	May Rio.	May.	Cecile.	Gladys.	Betty.
Beginning,	863	782	993	693	788	758
End,	875	793	940	673	798	760
Gain or loss,	12+	11+	—53	—20	10+	2+

[1] Sixteenth report of the Hatch Experiment Station, p. 47.

[2] It was not considered of sufficient importance to make an actual digestion trial with the normal ration; neither were all the feed stuffs entering into its composition completely analyzed, hence average coefficients of the individual concentrates could not be employed.

TABLE VI. — *Average Weight of Each Cow at Beginning and End of Each Period (Pounds)* — Con.

First period, Herd II.

	Blanche.	Fancy.	Susie.	Samantha.	Maude.	Red II.
Beginning,	1,202	885	650	957	868	1,013
End,	1,198	892	653	965	893	1,020
Gain or loss,	—4	7+	3+	8+	25+	7+

Second period, Herd I.

	Daisy.	May Rio.	May.	Cecile.	Gladys.	Betty.
Beginning,	893	812	1,005	693	818	767
End,	883	812	995	677	800	777
Gain or loss,	—10	-	—10	—16	—18	10+

Second period, Herd II.

	Blanche.	Fancy.	Susie.	Samantha.	Maude.	Red II.
Beginning,	1,210	908	652	1,002	915	1,040
End,	1,153	907	657	972	927	1,042
Gain or loss,	—57	—1	5+	—30	12+	2+

Third period, Herd I.

	Daisy.	May Rio.	May.	Cecile.	Gladys.	Betty.
Beginning,	893	810	1,002	677	798	775
End,	915	838	1,002	672	817	785
Gain or loss,	22+	28+	-	—5	19+	10+

Third period, Herd II.

	Blanche.	Fancy.	Susie.	Samantha.	Maude.	Red II.
Beginning,	1,140	935	670	980	942	1,053
End,	1,145	977	702	1,035	977	1,050
Gain or loss,	5+	42+	32+	55+	35+	—3

In the first period the first weights were made at the beginning of the preliminary period; in the other two periods at the beginning of the periods proper. In the first period Herd I. showed only slight variations, excepting May, which lost some 53 pounds, and evidently was not receiving quite sufficient nutriment. In the same period Maude was evidently eating a little more than was required.

In the second period proper of 28 days, 4 of the cows in Herd I. showed a little loss in live weight; the animals in Herd II. manifested only slight variations, excepting Samantha and particularly Blanche. Samantha during most of her milking period did not appear to be in first-class condition, although she ate her food clean and gave no evidence of pronounced indisposition. The loss in live weight in case of Blanche was due to the intestinal disturbance already referred to. In the third period both herds made a noticeable increase of weight, due to the advance in lactation and the consequent milk shrinkage.

TABLE VII. — *Average Gain or Loss of Each Herd (Pounds).*

Herds.	Number of Cows.	First Period.	Second Period.	Third Period.
Herd I.,	6	-38	-44	+74
Herd II.,	6	+46	-69	+166

The average gain or loss in weight makes clear that each herd was well nourished, and that during the several periods, extending over four months, the variations in weight were not more than would have been expected.

TABLE VIII. — *Total Amount of Milk produced by Each Cow in Each Herd (Pounds).*

Herd I.

Cows.	First Period, Fourteen Days.	Second Period, Twenty-eight Days.	Third Period, Twenty-one Days.
Daisy,	261.96	498.29	370.69
May Rio,	248.45	491.25	357.41
May,	334.25	659.03	479.53
Cecile,	333.83	643.64	460.05
Gladys,	314.81	609.91	436.06
Betty,	325.84	583.39	409.79
Average,	303.19	580.92	418.92

TABLE VIII. — *Total Amount of Milk produced by Each Cow in Each Herd (Pounds)* — Con.

Herd II.

Cows.	First Period, Fourteen Days.	Second Period, Twenty-eight Days.	Third Period, Twenty-one Days.
Blanche,	336.47	649.28	466.58
Fancy,	270.94	545.88	439.55
Susie,	144.33	312.03	248.68
Samantha,	328.70	731.02	562.82
Maude,	158.96	293.66	201.40
Red II.,	384.56	811.15	444.28
Average,	270.66	557.17	393.89

TABLE IX. — *Average Amount of Milk produced daily by Each Cow (Pounds).*

Herds.	Number of Cows.	First Period.	Second Period.	Third Period.
Herd I.,	6	21.66	20.75	19.95
Herd II.,	6	19.33	19.90	18.76

In the first period Herd I. was producing nearly 12 per cent. more milk than Herd II., in the second period over 4 per cent. more, and in the third period about 6 per cent. more.

Table IX., giving the average daily amount yielded by each cow, shows that a fair flow was maintained by both herds during the entire experiment.

Effect of Food upon the Composition and Quality of the Products.

Table X. — *Composition of the Milk (Per Cent.).*

First period: both herds, normal grain ration.

Samples.	Total Solids.		Fat, Herd I.		Fat, Herd II.		Solids not Fat.		Ash.		Nitrogen.		Protein.		Lactose.	
	Herd I.	Herd II.	Gravimetric Method.	Babcock Method.	Gravimetric Method.	Babcock Method.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
Jan. 12-17,	14.88	14.83	5.32	5.48	5.18	5.25	9.56	9.65	.771	.796	.605	.609	3.78	3.81	4.83	4.87
Jan. 19-24,	14.87	14.68	5.44	5.53	5.10	5.25	9.43	9.58	.755	.775	.591	.606	3.70	3.79	4.92	4.96
Average,	14.88	14.76	5.38	5.51	5.14	5.25	9.50	9.62	.763	.786	.598	.608	3.74	3.80	4.88	4.92

Second period: Herd I., normal grain ration: Herd II., soy bean meal ration.

Samples.	Total Solids, Herd I.	Total Solids, Herd II.	Fat, Herd I., Gravimetric Method.	Fat, Herd I., Babcock Method.	Fat, Herd II., Gravimetric Method.	Fat, Herd II., Babcock Method.	Solids not Fat, Herd I.	Solids not Fat, Herd II.	Ash, Herd I.	Ash, Herd II.	Nitrogen, Herd I.	Nitrogen, Herd II.	Protein, Herd I.	Protein, Herd II.	Lactose, Herd I.	Lactose, Herd II.
Jan. 26-31,[1]	14.66	14.72	5.14	5.20	5.10	5.15	9.52	9.52	-	-	-	-	-	-	-	-
Feb. 2-7,[1]	14.82	14.83	5.36	5.40	5.21	5.20	9.46	9.43	-	-	-	-	-	-	-	-
Feb. 9-14,	14.86	14.71	5.31	5.40	5.04	5.25	9.55	9.67	.779	.783	.604	.648	3.84	4.05	4.87	4.92
Feb. 16-21,	14.94	14.75	5.40	5.17	5.55	5.33	9.54	9.20	.784	.778	.611	.614	3.82	3.84	4.96	4.98
Feb. 23-28,	14.94	14.64	5.29	5.45	5.05	5.25	9.65	9.59	.772	.758	.610	.609	3.81	3.80	4.91	4.91
Mar. 2-7,	14.86	14.67	5.24	5.43	5.02	5.25	9.62	9.65	.734	.752	.599	.615	3.74	3.85	4.97	4.94
Average,	14.90	14.69	5.31	5.36	5.17	5.27	9.59	9.53	.767	.768	.606	.622	3.80	3.89	4.93	4.94

Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.

Mar. 12-15,[1] . .	14.84	14.70	–	5.53	–	5.25	–	–	–	–	–	–	–	–	–	–
Mar. 15-19,[1] . .	14.65	14.65	–	5.25	–	5.10	–	–	–	–	–	–	–	–	–	–
Mar. 20-21,[1] . .	14.87	14.96	–	5.35	–	5.35	–	–	–	–	–	–	–	–	–	–
Mar. 22-23,[1] . .	14.87	14.70	–	5.35	–	5.30	–	–	–	–	–	–	–	–	–	–
Mar. 24-26,[1] . .	15.05	15.15	–	5.40	–	5.55	–	–	–	–	–	–	–	–	–	–
Mar. 27-29,[1] . .	14.98	14.71	–	5.55	–	5.35	–	–	–	–	–	–	–	–	–	–
Mar. 30-Apr. 4, .	14.96	14.87	5.32	5.40	5.29	5.38	9.64	9.47	.752	.759	.604	.590	3.78	3.68	4.90	4.90
Apr. 6-11, . .	15.27	14.81	5.45	5.70	5.10	5.30	9.82	9.71	.756	.759	.614	.610	3.84	3.81	4.99	4.99
Apr. 13-18, . .	15.12	14.73	5.39	5.45	5.08	5.23	9.73	9.65	.748	.758	.608	.606	3.80	3.79	4.98	4.97
Average, . .	15.12	14.80	5.39	5.52	5.16	5.30	9.73	9.61	.752	.759	.609	.602	3.81	3.76	4.96	4.95

After removal of oil.

Apr. 20-25, . .	15.11	14.52	5.33	5.50	4.74	5.00	9.78	9.78	.767	.772	.624	.612	3.90	3.83	4.93	4.97
Apr. 27-30, . .	15.11	14.31	5.40	5.50	4.76	4.90	9.71	9.55	–	–	–	–	–	–	–	–
May 6, . . .	15.11	14.65	5.37	5.40	4.85	5.00	9.74	9.80	–	–	–	–	–	–	–	–

[1] Preliminary.

Each analytical determination in the above table was from a five-day composite, taken as previously described. The total solids were determined by drying on sand; the fat by extracting the sand residue with water-free ether, and also by the Babcock method; the ash by evaporating the milk in a platinum dish with nitric acid and burning the residue at a low red heat; the nitrogen by the Kjeldahl-Gunning method; the lactose with the aid of Fehling's solution and the Low "zinc-acetate" method.

In the second and third periods the partial composition of the milk was ascertained during the preliminary period in order to note any immediate change resulting from the feeding of soy bean meal or soy bean oil.

In the first period Herd I. produced milk with a slightly higher percentage of total solid matter than did Herd II.; this evidently was due to the higher fat percentage in the former milk (5.38 against 5.14). The percentage of ash, nitrogen and lactose were nearly the same in each case. It may be said that the chemical composition of the milk from each of the two herds of 6 cows each, when fed the same ration, was substantially alike.

The addition of the soy bean meal (average of 2.3 pounds per cow daily in place of a like amount of normal grain ration) did not appear to have any noticeable effect upon the total solids or fat percentages of the milk produced by Herd II. during the preliminary period of two weeks. During the period proper, lasting four weeks, the average percentages of fat and solids not fat in case of both herds showed only slight differences from those in the first period,[1] and the same may be said of the lactose percentages. The ash and nitrogen percentages of the milk yielded by Herd I. were quite similar to those in the first period, while with Herd II. the ash showed a slight decrease and the nitrogen a very slight increase. One, however, would not consider it wise to attribute these variations directly to the modification of the grain ration.

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[1] During the week of February 16 to 21 the fat percentages as determined by the gravimetric method increased perceptibly, a change which cannot be accounted for. In most cases the gravimetric method gave lower results than the Babcock, while in this instance the reverse was the case.

In the third preliminary period, lasting from March 9 to 30, during which time the soy bean meal was removed and the oil added to the ration of Herd II., total solids and fat determinations were made in order to note any changes which might result during the process. No change could be observed, however, that might be attributed to the oil. In the three weeks of the period proper it is to be noted that the total solid matter in the milk produced by Herd I. had increased a little (from 14.88 in the first period to 15.12), due to the advance in lactation. The milk produced by Herd II. in the third period proper remained remarkably even in composition, and one could not say that the addition of the oil to the ration produced any noticeable effect in varying the proportions of its several constituents.

The above results are somewhat different from those secured with linseed,[1] cotton-seed,[2] and corn oils,[3] where there appeared to be an increase in the fat content of the milk (.15 to .50 per cent.) which lasted, however, in two out of three cases only for a week or two; the nitrogen was, on the contrary, slightly depressed.

After the completion of the third period the soy bean oil was suddenly removed and the composition of the milk analyzed and recorded. It will be seen that the percentage of fat in the milk of Herd II. suddenly dropped several tenths of a per cent., and after an interval of ten days began to come back to normal. Similar results were secured in previous experiments. This, it would seem, indicated that the fat in the food helped in the formation of the milk fat, and its sudden removal caused a temporary milk fat decrease. The animal, however, soon corrected the condition by making the fat from other sources.

Flavor of the Milk. — A sample of each cow's milk was taken several times during the second and third periods, and tested for odor and flavor, by two different parties, both when cold and warm. The milk was taken by one of the chemists immediately after it had been drawn, and was placed in thoroughly cleaned and well-dried glass-stoppered bottles. Each cow was given a number, so that the parties making the ob-

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1 Hatch Experiment Station, 13th report, p. 19.
2 Hatch Experiment Station, 14th report, p. 164.
3 Hatch Experiment Station, 16th report, p. 50.

servations would not know whether the samples came from one herd or the other. In the second period no differences or peculiarities were noted. In the third period the milk from each cow likewise appeared quite normal, except that produced by Red II., which had a strong odor and taste, which became especially pronounced towards the close of the period. This was due directly to the condition of the cow already referred to. In neither the second nor third period did it seem possible to detect any objectionable condition due to the soy bean meal or oil.

Chemical Composition of the Butter Fat. — In describing this experiment it is not intended to discuss the constitution of the butter fat molecule. It is believed that butter fat consists primarily of the triglycerides olein, palmitin, myristin and butyrin, united in simple molecules. Investigations by J. Bell,[1] Blythe[2] and others have indicated, however, that a portion of the different fatty acids may be bound together in a complex molecule ($C_3H_5\leqq$). In the tables of analyses which follow, all of the important constants are given as well as considerable other data of interest, a portion of which was obtained by actual analysis and a portion by mathematical calculation. The results are indicative of the changes which took place when an excess of soy bean oil was fed, but the methods thus far available are not adequate to give a complete understanding of the changes brought about as a result of the addition of oil to the ration. Such knowledge can be secured only by a more exhaustive investigation of the chemistry of the entire subject. Work along this line is already planned.[3]

The analyses in connection with the present experiment were made by Mr. E. B. Holland, assisted by P. H. Smith and L. S. Walker. The methods followed were substantially those of the Association of Official Agricultural Chemists, with such modifications as circumstances seemed to warrant. It is not considered necessary to describe the several methods in detail.

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1 Chemistry of Foods, second edition, p. 44.

2 Proceedings of Chemical Society, 1889, p. 5; from Lewkowitsch, third edition, Vol II., p. 839.

3 For lack of space it has been necessary to hold a number of valuable papers for later publication. It is hoped to include these, and a report upon an original investigation now in progress by Dr. R. D. MacLaurin on "The Constitution of Fats and the Chemistry of Fat Formation," in our next annual report.

Sufficient information will be given in the proper place to enable the reader to have a clear understanding of the processes employed.

The butter from which the samples for analyses were prepared was taken shortly after churning, melted, filtered through a jacketed funnel into clean bottles, stoppered, and set away at an approximate temperature of 40° to 45° F. until used. The samples of fat were examined as soon as possible after the close of the period; it is evident, however, that some four to six weeks elapsed between the preparation and examination of the first samples. This, in some respects was unfortunate, inasmuch as slight changes would occur. Because of the large number of samples to be examined the condition could not well have been avoided. It is believed that the low temperature and the exclusion of air prevented any serious changes. Each analysis represents a composite of two weekly samples.

TABLE XI. — *Butter Fat Constants.*

First period: both herds, normal grain ration.

Sample Number.	Saponification Number.		Reichert-Meissl Value.		Iodine Number.		Oleic Acid Equivalent.		Melting Point.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
17261-2,	236.40	232.26	31.00	27.14	25.85	29.08	28.70	32.28	34.00	33.58
17263-4,	235.37	232.22	30.38	28.12	26.05	29.00	28.92	32.20	33.75	33.60
17265-6,	236.12	231.76	30.34	27.05	26.46	29.25	29.38	32.47	33.90	33.58
17267-8,	234.74	232.30	29.10	26.77	27.18	29.91	30.18	33.21	34.20	33.68
Average,	235.66	232.13	30.21	27.27	26.39	29.31	29.30	32.54	33.96	33.61
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.										
17269-70,	234.32	232.28	29.78	26.73	27.47	31.46	30.50	34.93	34.25	33.05
17271-2,	234.34	232.81	28.81	27.15	27.12	30.65	30.11	34.03	33.80	33.08
17273-4,	234.58	232.01	29.21	27.12	27.30	31.43	30.31	34.89	33.98	33.50
17275-6,	236.06	232.20	28.83	27.90	27.25	31.69	30.25	35.18	34.03	33.58
17277-8,	236.51	232.45	29.78	27.61	26.81	31.13	29.77	34.56	33.75	33.53
17279-80,	235.04	231.59	29.67	27.00	28.00	32.00	31.09	35.53	33.70	33.30
17521-2,	233.55	230.61	29.19	26.75	28.23	33.08	31.34	36.73	33.75	33.05
17523-4,	232.24	228.80	28.55	26.15	28.38	33.77	31.51	37.49	33.95	33.63
Average,	234.58	231.59	29.23	27.05	27.57	31.90	30.61	35.42	33.90	33.34
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.										
17525-6,	230.92	222.42	29.00	24.29	27.82	38.49	30.89	42.73	33.75	32.95
17527-8,	231.68	222.44	28.00	24.20	27.26	38.60	30.27	42.86	33.65	32.90
17529-30,	232.14	222.68	28.24	23.52	27.71	39.12	30.76	43.43	33.65	32.70
17531-2,	231.59	221.65	28.43	22.94	27.95	40.61	31.03	45.09	33.78	32.93
17533-4,	232.02	221.07	29.49	23.12	28.32	41.46	31.44	46.03	33.65	32.60
17535-6,	232.56	221.16	29.99	22.79	27.54	41.63	30.58	46.22	33.85	32.75
17537-8,	232.76	220.83	29.84	23.09	27.71	41.22	30.76	45.76	33.95	33.03
17539-40,	232.07	220.97	29.17	22.21	27.18	40.84	30.17	45.34	33.95	33.43
Average,	231.97	221.65	29.02	23.27	27.69	40.25	30.74	44.68	33.78	32.91

The saponification or Köttstorfer value represents the number of milligrams of potassium hydrate necessary to completely saponify one gram of fat. In case of butter fat, Brown[1] states that the probable mean[2] is 228.5, with extremes of 224 and 234.9; Thorpe[3] shows variations of from 219.7 to 232.6.

In butter fat a high saponification value is accompanied by a relatively high Reichert-Meissl value and a relatively low iodine value. This is natural, for a high percentage of oleic acid having a low combining power would increase the amount of iodine absorbed; and, *vice versa,* an increase in the percentage of soluble fatty acids of high combining power (Reichert-Meissl value) would increase the saponification and depress the iodine value.

In the first period it is shown, in the above table, that both herds produced butter fat with relatively high saponification values; such a condition may be considered characteristic of the animals, all of which were grade or pure-bred Jerseys and none in an advanced stage of lactation. Herd I. yielded a fat with a little higher saponification value than Herd II. The former herd likewise showed a higher Reichert-Meissl[4] and a lower iodine value.[5] The melting point[6] of the fat produced by Herd I. was also a trifle higher than from Herd II., although this test is not sufficiently delicate to enable one to place much value upon it.

The results of the various determinations all point to the fact that in the first period, with both herds receiving the same ration, Herd I. yielded butter fat with slightly less insoluble fats (especially olein) and slightly more soluble fats than Herd II.

In the second period, in case of Herd II. 2.3 pounds per day of soy bean meal replaced a like amount of normal ration. It may be recalled that the partially extracted soy bean meal as fed contained some 45 per cent. of protein and 9 per cent. of fat, while a normal soy bean meal averages about 35 per cent. protein and 18 per cent. fat. The influence of the bean on the

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1 Pennsylvania Experiment Station, report, 1899-1900, pp. 226 to 245.
2 Average of 40 samples.
3 Lewkowitsch, third edition, Vol. II., p. 834, calculated from 357 English analyses.
4 Leffmann-Beam modification.
5 Wijs' modification.
6 Wiley method.

butter fat might be attributed in part to the bean protein and in part to the bean oil. A careful study of the analytical data fails to reveal any marked differences that could be attributed to the change in the ration. In the butter fat from Herd II. the higher iodine number might indicate a small increase in the amount of unsaturated acids beyond that resulting from the advance in the period of lactation. If such were the case the increase in all probability would be attributed to the influence of the oil rather than to the bean protein.

In the third period, when the bean meal was replaced by the normal ration (Herd II.) and an average per day and head of .6 of a pound of soy bean oil was added, striking differences are noted. In case of Herd I. (normal ration) the Köttsdorfer number dropped from an average of 234.58 to 231.97, — some 3½ points, — while with Herd II. it fell from 231.59 to 221.65, — a difference of 10 points. The former decline was due largely to the advance in the milking period, and perhaps to a slight decomposition in the fat, while the latter decline must have resulted, to a considerable extent, from the feeding of the bean oil. The Reichert-Meissl number in the fat of Herd I. fell slightly from that in the second period (29.23 to 29.02); in the fat from Herd II. it dropped from 27.05 to 23.27, showing a marked decrease in the amount of soluble fats. The iodine value of the fat produced by Herd I. was similar to that in the second period, while with Herd II. it increased from 31.90 to 40.25, giving additional evidence of the increase of oleic and possibly of linolic acids. In terms of oleic acid, by calculation,[1] this increase amounts to 9.26 points, it being 35.42 in the second period and 44.68 in the third period.

The determination of the important constants, therefore, makes clear that the addition of the bean meal, with a high percentage of bean protein, had little if any effect upon the chemical composition of the butter fats. The feeding of the bean oil, on the other hand, depressed the volatile fats and noticeably increased the percentage of unsaturated acid. Whether the bean oil entered directly into the butter fat molecule without change resulting from its passage through the digestive and

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[1] Oleic acid $= \frac{\text{iodine number}}{.9007}$ (based on a combining weight of 127 for iodine).

circulatory systems has not been fully demonstrated. Results similar to the above have been secured at this station by feeding corn, cotton-seed and linseed oils.[1]

In addition to a determination of the several constants reported in Table XI., numerous other determinations were made which are given in the following table: —

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[1] Hatch Experiment Station, *loco citato*.

TABLE XII. — *Chemical and Physical Data of the Butter Fat.*

First period: both herds, normal grain ration.

Sample Number.	Acid Number (Mgs. KoH).		Ether Number (Mgs. KoH).		Free Fatty Acids (Per Cent.).		Glycerol.		Total Fatty Acids.		Valenta Test.		Refractive Index.		Mean Dispersion.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
17261-2, . .	.40	.32	236.00	231.94	.18	.14	12.90	12.68	94.67	94.77	40.00	42.50	1.4528	1.4530	.00842	.00869
17263-4, . .	.43	.43	234.94	231.79	.19	.19	12.84	12.67	94.70	94.77	39.50	42.00	1.4525	1.4532	.00827	.00870
17265-6, . .	.29	.33	235.83	231.43	.13	.15	12.89	12.65	94.68	94.78	40.00	43.00	1.4525	1.4531	.00827	.00881
17267-8, . .	.31	.33	234.43	231.97	.14	.15	12.81	12.68	94.71	94.76	41.00	43.50	1.4527	1.4535	.00868	.00856
Average,	.36	.35	235.30	231.78	.16	.16	12.86	12.67	94.69	94.77	41.13	42.75	1.4526	1.4532	.00841	.00869
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.																
17269-70, .	.40	.35	233.92	231.93	.18	.16	12.78	12.68	94.72	94.77	41.50	43.50	1.4528	1.4525	.00828	.00897
17271-2, . .	.37	.34	233.97	232.47	.17	.15	12.79	12.70	94.72	94.75	41.00	43.50	1.4525	1.4535	.00815	.00911
17273-4, . .	.39	.30	234.19	231.71	.18	.13	12.80	12.66	94.71	94.77	40.50	44.50	1.4529	1.4535	.00843	.00844
17275-6, . .	.35	.30	235.71	231.90	.16	.13	12.88	12.67	94.68	94.77	40.50	44.50	1.4526	1.4531	.00868	.00910
17277-8, . .	.34	.26	236.17	232.19	.15	.12	12.91	12.69	94.67	94.76	39.00	43.50	1.4525	1.4530	.00827	.00843
17279-80, .	.36	.30	234.68	231.29	.16	.13	12.83	12.64	94.70	94.78	40.50	45.00	1.4529	1.4532	.00817	.00963
17521-2, . .	.45	.34	233.10	230.27	.20	.15	12.74	12.58	94.74	94.80	41.50	44.50	1.4528	1.4535	.00895	.00911
17523-4, . .	.40	.36	231.84	228.44	.18	.16	12.67	12.48	94.77	94.84	43.75	48.25	1.4530	1.4537	.00895	.00938
Average,	.38	.32	234.20	231.27	.17	.14	12.80	12.64	94.71	94.78	41.03	44.66	1.4528	1.4534	.00849	.00902
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.																
17525-6, . .	.42	1.62	230.50	220.80	.19	.73	12.60	12.07	94.80	95.02	41.50	51.50	1.4530	1.4550	.00802	.00940
17527-8, . .	.53	1.23	231.15	221.21	.24	.55	12.63	12.09	94.78	95.01	40.50	52.00	1.4528	1.4549	.00790	.00873
17529-30, .	.57	1.17	231.57	221.51	.26	.53	12.65	12.11	94.77	95.00	41.00	52.25	1.4528	1.4549	.00816	.00890
17531-2, . .	.54	1.37	231.05	220.28	.24	.62	12.63	12.04	94.79	95.03	42.50	53.50	1.4530	1.4550	.00828	.00885
17533-4, . .	.65	2.43	231.37	218.64	.29	1.09	12.64	11.95	94.78	95.07	41.50	52.50	1.4529	1.4550	.00828	.00859
17535-6, . .	.36	.83	232.20	220.33	.16	.37	12.69	12.04	94.76	95.03	41.50	54.00	1.4529	1.4551	.00802	.00859
17537-8, . .	.31	.91	232.45	219.92	.14	.41	12.70	12.02	94.75	95.04	41.50	54.00	1.4529	1.4551	.00828	.00885
17539-40, .	.43	1.55	231.64	219.42	.19	.70	12.66	11.99	94.77	95.05	41.00	54.00	1.4529	1.4550	.00802	.00873
Average,	.48	1.39	231.49	220.26	.21	.62	12.65	12.04	94.78	95.03	41.38	52.97	1.4529	1.4550	.00812	.00874

The acid number, obtained by heating a definite quantity of the fat in alcohol, allowing it to cool and titrating the solution with tenth normal alkali, represents the number of milligrams of potassium hydrate necessary to neutralize the free acid in one gram of fat. The column headed free fatty acids was calculated by the use of a mean molecular weight of 252.

Inasmuch as the butter fat was prepared directly after the butter was made, the small amount of acidity could not be due to the action of bacteria, since butter fat offers no suitable medium for bacterial development. It is not believed that the acidity was due to a decomposition of the glycerides, as the low temperature and exclusion of air would not be favorable to such a transformation. Brown[1] has shown that fresh butter fat has an acid number of .50; Lewkowitsch[2] likewise calls attention to a similar condition.

In the above table it will be seen that in the first two periods both herds showed quite similar acid numbers, varying from .32 to .38, equivalent to from .14 to .17 per cent. of acidity. In the third period, in case of Herd I. the acid number increased slightly to .48, and noticeably in case of Herd II. from an average of .32 in the second period to 1.39. This change could not have been due to the effect of long standing, otherwise the butter fat from Herd I. would have shown a similar condition. It may have been due partly to the direct entrance of the soy bean oil[3] into the butter fat and partly to the disturbance as the result of feeding the oil.

The ether number, or difference between the saponification and the acid numbers, represents the milligrams of potassium hydrate required to neutralize the acids of the neutral fat. Naturally it varied with the saponification and acid numbers, being lowest in the butter fat produced by Herd II. in the third period.

The percentage of glycerol in fat may be determined directly according to the method worked out by Benedict and Zsigmondy[4] and modified by Allen,[5] or in case of triglycerides it

[1] Pennsylvania State College, report *loco citato*.

[2] Lewkowitsch, *loco citato*.

[3] The soy bean oil had an acid number of 1.27.

[4] Journal Society Chemical Industry, 1885, p. 610; abs. Lewkowitsch, third edition, Vol. I., p. 283.

[5] Commercial Organic Analyses, second edition, II., p. 290.

may be calculated from the ether number.[1] The above results were secured by the latter method on the understanding that 3 molecules of potassium hydrate replace 1 molecule of glycerol: —

$$168.474 : 92.064 :: 1 : G.$$

in which case G = .5465.

Multiplying the ether number, therefore, by .05465 gives the percentage of glycerol. Direct determinations of glycerol in neutral fats by quantitative methods, and by the above method of calculation, have given substantially identical results. Thus, Brown found in beef tallow 10.61 per cent. by determination and 10.68 by calculation, and in butter fat 12.70 and 12.69 per cent. respectively.[2] Bell has found 12.54 per cent. of glycerol in genuine butter fat.[3] Our own results compared very closely to the above figures, excepting in the case of Herd II. in the third period, when the average falls to 12.04 per cent. This is in harmony with results already presented, and indicates a decrease in the amount of the soluble acids of high combining power and low molecular weight and a corresponding increase in the insoluble fats.

The percentage of total fatty acids was calculated in accordance with the formula presented by Zulkowsky.[4] This method, in common with that for the determination of the glycerol, depends upon the determination of the ether number. The formula is as follows: —

$$C_3H_5(RO_2)_3 + 3\ H_2O = C_3H_5(OH)_3 + 3\ RO_2H$$

Fat + water (54.048) = glycerol (92.064) + fatty acids.

$$\text{Fatty acids} = 100 + \frac{54.048}{92.064} G - G; \text{ or } 100 - \frac{38.016}{92.064} G.$$

Substituting the value of glycerol in terms of ether number: —

$$F = 100 - \frac{38.016}{92.064} \times .05465\ E \text{ or } 100 - .02257\ E.$$

The total fatty acids as presented in the tables are all quite uniform, excepting for Herd II. in the last period, when they increased slightly, for the reason already mentioned.

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1 Lewkowitsch, third edition, Vol. I., p. 281; original by Zulkowsky, Berichte, 16, p. 1140.

2 *Loco citato*, p. 216.

3 Lewkowitsch, p. 833.

4 Berichte, 16, p. 1315.

The Valenta test, as modified by Allen,[1] was employed in securing the reported results, and consisted in warming 3 cubic centimeters of melted butter fat with an equal quantity of glacial acetic acid in a test tube with agitation until complete solution took place. The solution was allowed to cool while being stirred with a thermometer and the temperature noted at which the solution became turbid. Allen gives temperatures of from 56° C. to 61.5° C. for pure butters. Our own temperatures, for some unexplained reason, were noticeably lower; they are at least comparable. It will be noted that in the first period Herd I. had a slightly lower turbidity point than Herd II., showing, as have other tests, a slight difference in the composition of the butter fat. In the second period this difference was more noticeable, and was very marked in the third or soy bean oil period, amounting to nearly 12°. It would appear that the higher the percentage of olein in the butter the higher was the point of turbidity. Whether the excess of free fatty acids had anything to do with the higher point of turbidity is uncertain.[2]

The refractive index on the various samples was made with a water jacketed Abbé refractometer at 40° C., according to the instructions given. Only in the third period in case of Herd II. does one note a slight variation and increase over the fat produced in the other two periods.

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[1] Lewkowitsch, p. 862.   [2] Lewkowitsch, p. 218.

TABLE XIII. — *Data of the Fatty Acids.*

First period: both herds, normal grain ration.

Sample Number.	Insoluble Acids (Hehner Number).						Soluble Fatty Acids.						Volatile Fatty Acids.			
	Percentage.		Saponification Number.		Mean Molecular Weight.		Percentage.		Saponification Number.		Mean Molecular Weight.		Saponification Number.		Mean Molecular Weight.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
17261-2, . .	86.56	87.24	215.19	214.54	260.96	261.76	8.11	7.53	618.13	598.94	90.85	93.76	553.94	554.87	101.38	101.21
17263-4, . .	86.72	87.24	213.35	213.01	263.22	263.64	7.98	7.53	630.95	616.07	89.01	91.16	555.41	559.29	101.11	100.41
17265-6, . .	86.63	87.28	212.33	213.29	264.48	263.29	8.05	7.50	648.20	608.00	86.64	92.37	548.26	548.63	102.43	102.36
17267-8, . .	86.74	87.68	214.69	214.04	261.58	262.37	7.97	7.08	608.78	630.37	92.25	89.09	555.85	556.57	101.03	100.90
Average, .	86.66	87.36	213.89	213.72	262.56	262.76	8.03	7.41	626.72	613.35	89.69	91.60	553.37	554.84	101.49	101.22

Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.

Sample Number.	Insoluble Percentage Herd I.	Insoluble Percentage Herd II.	Insoluble Saponification Number Herd I.	Insoluble Saponification Number Herd II.	Insoluble Mean Molecular Weight Herd I.	Insoluble Mean Molecular Weight Herd II.	Soluble Percentage Herd I.	Soluble Percentage Herd II.	Soluble Saponification Number Herd I.	Soluble Saponification Number Herd II.	Soluble Mean Molecular Weight Herd I.	Soluble Mean Molecular Weight Herd II.	Volatile Saponification Number Herd I.	Volatile Saponification Number Herd II.	Volatile Mean Molecular Weight Herd I.	Volatile Mean Molecular Weight Herd II.
17269-70, .	86.54	87.02	213.82	215.05	262.64	261.14	8.18	7.75	602.44	582.45	93.22	96.42	556.74	553.94	100.87	101.38
17271-2, . .	86.82	86.60	214.68	214.88	261.59	261.35	7.90	8.15	606.96	573.25	92.52	97.96	552.46	560.96	101.65	100.11
17273-4, . .	86.74	87.52	212.95	211.68	263.71	265.30	7.97	7.25	625.72	644.83	89.75	87.09	558.95	557.62	100.47	100.71
17275-6, . .	86.22	86.65	210.01	210.26	267.41	267.09	8.46	8.12	650.00	615.89	86.40	91.18	549.22	564.29	102.25	99.52
17277-8, . .	86.40	86.99	211.93	207.92	264.98	270.09	8.27	7.77	645.71	663.84	86.97	84.60	553.88	553.28	101.39	101.50
17279-80, .	86.39	87.33	212.05	210.07	264.83	267.33	8.31	7.45	623.95	646.17	90.00	86.91	555.85	557.23	101.03	100.78
17521-2, . .	86.75	86.96	211.95	210.11	264.96	267.28	7.99	7.84	621.78	610.97	90.32	91.92	551.00	547.03	101.02	102.66
17523-4, . .	86.83	87.17	211.38	207.56	265.67	270.56	7.94	7.67	613.35	624.12	91.56	89.98	544.59	552.41	103.12	101.66
Average, .	86.59	87.03	212.35	210.94	264.47	266.27	8.13	7.75	623.24	620.19	90.09	90.76	552.84	555.85	101.59	101.04

Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.

17525-6, . .	86.59	88.53	213.20	207.87	263.41	270.16	8.21	6.49	564.07	591.53	99.56	94.94	547.03	554.21	102.66	101.33
17527-8, . .	87.23	88.43	215.00	208.16	261.20	269.78	7.55	6.58	584.64	582.98	96.06	96.33	539.88	556.19	104.02	100.97
17529-30, .	87.04	88.77	213.78	208.83	262.69	268.92	7.73	6.23	595.99	598.72	94.23	93.80	543.27	551.76	103.37	101.78
17531-2, . .	87.23	89.01	214.20	205.41	262.18	273.39	7.56	6.02	591.80	644.68	94.89	87.11	543.90	556.68	103.25	100.88
17533-4, . .	87.25	89.17	213.05	205.59	263.59	273.16	7.53	5.90	612.62	639.83	91.67	87.77	554.54	562.93	101.27	99.76
17535-6, . .	87.91	88.99	213.92	205.48	262.52	273.30	6.85	6.04	649.63	634.11	86.45	88.56	562.59	556.57	99.82	100.90
17537-8, . .	87.08	88.80	212.20	205.65	264.65	273.08	7.67	6.24	625.55	612.34	89.77	91.71	554.65	561.47	101.25	100.02
17539-40, .	87.74	89.51	212.71	205.64	264.01	273.09	7.03	5.54	646.37	666.06	86.88	84.31	558.12	557.17	100.62	100.79
Average, .	87.26	88.90	213.51	206.58	263.03	271.86	7.52	6.13	608.83	621.28	92.44	90.57	550.50	557.12	102.03	100.80

The insoluble fatty acids, or Hehner number, were determined by saponifying in a flask a definite amount of fat with a glycerol-soda solution, destroying the resulting soap with dilute hydrochloric acid, solidifying the insoluble fatty acids in ice water, and filtering; the acids, after repeated washing, solidifying and filtering, were eventually weighed in the flask. It is, of course, understood that all details and precautions were fully observed.

In the first period Herd II. showed a slightly higher percentage than did Herd I.; the same condition was observed in the second period. In the third period this difference was increased, due in a measure to the effect of the soy bean oil in increasing the unsaturated acids.

The saponification number of the insoluble acids was obtained by titrating the weighed acids, dissolved in alcohol with N/2 alkali solution; the number of milligrams of potassium hydrate required to neutralize 1 gram of fatty acids is the saponification number. But very little difference was noted until the third period, when in case of Herd II. a noticeable depression was observed.

The mean molecular weight (M) of the insoluble acids was calculated from the saponification number (S) by the formula

$$M = \frac{56158}{S.}$$

The soluble fatty acids represent the difference between the total and insoluble acids. The fat produced by Herd I. (first period) had rather more than did that yielded by Herd II. (also indicated by the Reichert-Meissl number). In the second period the fat from Herd I. contained about the same percentage, the amount being reduced in the third period by one-half per cent., due, probably, to the advance in the lactation period. Herd II. in the second period showed a slight decrease, from 8.13 per cent. in the first period to 7.75 per cent., and in the third period the percentage had fallen to 6.13.

The saponification of the soluble acids was calculated as follows: knowing the saponification number of the fat, the percentage and saponification number of the insoluble acids, and the percentage of soluble acids: —

235.66 mgs. KoH required to saponify 1 gram fat.
213.89 mgs. KoH equals saponification number of insoluble fats.
86.66 equals per cent. of insoluble acids.
$.8666 \times 213.89 = 185.35$ mgs. KoH to saponify insoluble acids in 1 gram fat.
$235.66 - 185.35 = 50.30$ mgs. KoH required to saponify soluble acids in 1 gram fat.
$50.30 \div .0803 = 626.46$ theoretical saponification number of soluble acids.

The mean molecular weight of the soluble acids was calculated by the same formula as in case of the insoluble acids.

The mean molecular weight of the volatile acids was determined by evaporating to dryness the titrated portion resulting from the Reichert-Meissl number. From the weight of the salts and of the alkali present in them the mean molecular weight can be readily calculated by the following formula: —

$$M = \frac{40.058\ [\text{salts} - (\text{c.c. } N/10\ \text{NaOH} \times .0040058)]}{\text{c.c. } N/10\ \text{NaOH} \times .0040058} + 18.016$$

$$= \frac{10000\ [\text{salts} - (\text{c.c. } N/10\ \text{NaOH} \times .0040058)]}{\text{c.c. } N/10\ \text{NaOH}.} + 18.016$$

Every precaution was taken and blank determinations were made on all of the reagents and deducted.

The saponification number (S) of the volatile fatty acids was obtained from the mean molecular weight (M), as follows: —

$$S = \frac{56158}{M}$$

The figures which follow represent the averages of analyses made in the experiment described. Number I. includes an average of all the data excepting those from Herd II. in the third or soy bean oil period. Because the soy bean oil so distinctly modified the composition of the fat the average for this period is presented by itself under Number II. Number III. represents the analysis of a sample of superior butter sent by Gude Brothers of New York. Number IV. represents the maximum and minimum tests usually recognized, with the approximate averages.

Table XIV. — *Complete Analytical Data of Butter Fat.*[1]

	Number I.	Number II.	Number III.	Number IV.
Number of cows,	12	6	–	–
Length of period (days),	109	35	–	–
Number of samples composited,	80	16	1	–
Number of determinations,	40	8	1	–
Neutral fat (per cent.),	99.83	99.38	99.74	–
Saponification number,	233.01	221.65	224.04	227 [2] 219.7–233.4
Acid number,	.38	1.39	.57	.50 [3] .20–.66
Ether number,	232.06	220.26	223.47	228 [3] 223.5–234.4
Free fat acids (per cent.),	.17	.62	.26	–
Reichert-Meissl number,	28.51	23.27	26.10	24 [4] 26–38
Iodine number (Wijs),	28.75	40.25	37.52	33 [3] 25.7–37.9
Oleic acid (per cent.) (calculated),	31.92	44.68	41.66	–
Melting point,	33.70	32.91	32.35	32 [3] 31–34.7
Valenta test,	42.25	52.97	51.50	–
Refractive index (40° C., N_D),	1.4530	1.4550	1.4547	–
Mean dispersion ($N_F - N_C$),	.00855	.00884	.00966	–
Total fatty acids (per cent.),	94.75	95.03	94.96	94.85 [3] 94.72–94.94
Glycerol (per cent.),	12.71	12.04	12.21	12.46 [3] 12.24–12.79
Insoluble fatty acids (per cent.) (Hehner number),	86.97	88.90	88.54	87.5 [3] 85.5–90.1
Saponification number,	212.65	206.58	205.74	214.5 [3] 212.5–217.0
Mean molecular weight,	264.11	271.86	272.96	261 [3] 258.1–263.5
Soluble fatty acids (per cent.),	7.78	6.16	6.42	7.20 [3] 6.52–8.96
Saponification number,	618.05	621.28	652.34	571.7 [3] 563.7–577.3
Mean molecular weight,	90.98	90.57	86.09	98.12 [3] 97.17–99.52
Saponification number of volatile fatty acids.	553.32	557.12	549.98	–
Mean molecular wt. of volatile fatty acids.	101.50	100.80	102.11	–

Manufacture of the Butter. — The butter was made twice weekly during the first two periods by Instructor Brintnall of the college dairy school, and during the last period by N. J. Hunting, also an instructor in the school. The cows were well groomed and all ordinary precautions taken to insure cleanly conditions. The cream was separated by a United States separator, and the entire process of manufacture was carried out in the experiment station creamery especially set aside for such work and fitted with all modern conveniences. The complete data of the process will be found tabulated further on.

[1] In column Number IV., the number above represents the mean, and the numbers below with the dash between represent the extremes.

[2] Lewkowitsch. [3] Brown. [4] Minimum generally recognized.

Table XV. — *Chemical Composition of the Butter.*

Samples.	Water.		Fat.		Salt.		Curd.[1]	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
First period: both herds, normal grain ration.								
January 16,	14.19	14.82	81.86	82.26	2.83	2.11	1.12	.81
January 19,	15.94	14.46	79.83	81.37	2.81	3.03	1.42	1.14
January 23,	14.33	14.64	80.75	80.64	3.23	3.38	1.69	1.34
January 25,	15.20	14.84	80.09	80.77	3.02	2.88	1.69	1.51
Average,	14.92	14.69	80.63	81.26	2.97	2.85	1.48	1.20
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.								
February 13,	13.92	14.35	82.04	80.71	3.17	3.94	.87	1.00
February 15,	14.68	14.97	81.32	80.40	3.23	3.75	.77	.88
February 20,	13.78	12.79	82.17	83.75	2.73	2.37	1.32	1.09
February 22,	13.49	12.87	83.75	81.67	3.49	3.63	1.35	1.04
February 27,	12.69	12.77	82.92	81.66	3.13	4.43	1.26	1.14
March 1,	12.30	12.82	82.66	81.91	3.94	4.09	1.10	1.18
March 6,	13.17	14.72	83.73	81.67	2.30	2.75	.80	.86
March 8,	12.25	13.28	84.38	82.49	2.62	3.46	.75	.77
Average,	13.29	13.57	82.87	81.78	3.08	3.55	1.03	1.00
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.								
April 10,	13.37	15.09	81.92	80.01	3.67	3.86	1.04	1.04
April 11,	12.69	16.08	83.33	79.42	3.01	3.36	.97	1.14
April 12,	14.46	15.05	80.36	79.55	4.14	4.44	1.04	.96
April 16,	13.51	16.75	82.02	77.90	3.42	4.34	1.05	1.05
April 17,	13.68	17.02	81.90	77.40	3.39	4.66	1.03	.92
April 18,	13.27	16.82	82.72	78.11	4.66	2.83	1.18	1.26
April 19,	12.91	15.21	82.23	79.30	3.58	4.27	1.28	1.22
April 20,	13.48	17.85	82.04	76.28	3.39	4.67	1.09	1.20
Average,	13.42	16.23	82.07	78.50	3.78	4.05	1.09	1.10
Average of three periods,	13.67	14.86	82.10	80.36	3.34	3.61	1.14	1.08
Average of 40 samples,	14.26		81.23		3.47		1.11	

The following method was employed in analyzing the butter: approximately 5 grams were brought on to quartz sand in a flat-bottomed dish and heated at a low temperature until the

[1] Including natural ash.

bulk of the moisture was expelled, then dried at 100° C. for two to three hours. The residue was transferred to an S. & S. capsule and extracted with anhydrous ether in a continuous extractor and the fat weighed. The sand containing the salt was agitated with a definite quantity of water and the chlorine titrated in an aliquot with standard silver nitrate. Curd, including natural ash, was calculated by difference.

The butter was sampled immediately after it was worked and ready for packing. In the first two periods the analyses from each of the two herds were much the same, with only such minor variations as one would naturally expect. In the third period the butter from Herd II. contained noticeably more water than that from Herd I. This is explained on the ground that it was more difficult to work than that from Herd I., being of a soft, salvy nature. The butter maker found that by working it more this condition would become too pronounced.

Flavor and Body of the Butter. — The writer[1] made frequent observations upon pound prints made from each of the two herds. The butter was allowed to stand until it had reached a uniform temperature of 70° F., and then it was tested by pressing it with the finger, and by pushing a glass rod into it and noting the resistance. The butter was then gradually heated to 80° or thereabouts and further observations noted.

In the first period the several lots produced by both herds were fairly firm at 70° F., but at 80° a soft condition was noted, although the prints held their form fairly well. It was repeatedly noticed that the butter produced by Herd II. appeared to be slightly softer than that yielded by Herd I., and this result must be regarded as characteristic of the herd.

In the second or soy bean meal period the samples from both herds were quite firm at 62°, but even at that comparatively low temperature the butter produced by Herd II. appeared to be of a softer and more yielding character when pressed with the finger. At 70° this difference was still more marked, and at 80° the prints from Herd II. frequently went into a shapeless, slushy condition.

In the third period the above conditions were still more pro-

[1] J. B. Lindsey.

nounced. The butter from Herd I. was quite hard and firm at 70° F., and maintained its form fairly well at 80° to 85°, while that from Herd II. was noticeably soft at 70° and collapsed into a slushy mass at the higher temperature. The writer did not attempt to pronounce on the flavor.

Penetration Tests. — In order to still further establish the effect of the two rations on the body of the butter, penetration tests were made by Mr. Smith. By degrees of penetration is meant the number of millimeters a small glass plunger, weighing 10 grams when loaded with mercury, will penetrate the butter when dropped from a height of about 1 meter. The prints were removed from the refrigerator and allowed to stand for some time (over night) at ordinary room temperature. In the morning they were generally within a few degrees of the temperature of the surrounding atmosphere. Each print was tested in a number of places. The detailed results follow, and likewise a summary of the average results: —

TABLE XVI. — *Penetration Tests (Millimeters).*

Laboratory Number.	Herd.	Butter made.	Penetration Test made.	Temperature of Room (Degrees F.).	Temperature of Butter (Degrees F.).	Single Trials.	Average.
First Period.							
17261,	I.,	Jan. 15,	Jan. 27,	68	63	11, 11, 11.25, 10, 10, 10,	10.5
17262,	II.,	Jan. 15,	Jan. 27,	68	64	12.5, 12.5, 12, 15, 14, 15,	13.5
17263,	I.,	Jan. 17,	Jan. 27,	68	64	10.25, 11, 10, 10, 10.5, 10,	10.3
17264,	II.,	Jan. 17,	Jan. 27,	68	64	10.5, 10, 11, 10, 10, 10,	10.3
17265,	I.,	Jan. 22,	Jan. 27,	68	63	10.5, 10, 12, 12.5, 10, 10.3,	10.9
17266,	II.,	Jan. 22,	Jan. 27,	68	64	13, 13, 13.5, 12, 12.5, 12,	12.7
17267,	I.,	Jan. 24,	Jan. 27,	68	64.5	17, 17, 18, 15.5, 17, 15,	16.6
17268,	II.,	Jan. 24,	Jan. 27,	68	64	18.5, 19, 18.5, 24, 21, 21,	20.3
Second Period.							
17269,	I.,	Feb. 13,	Feb. 15,	64	64	11, 11, 11, 10, 10, 10.5,	10.6
17270,	II.,	Feb. 13,	Feb. 15,	64	64	16, 17, 18.5, 15, 17, 17,	16.8
17271,	I.,	Feb. 15,	Feb. 18,	68	64	10.5, 14, 13, 14, 12, 13,	12.8
17272,	II.,	Feb. 15,	Feb. 18,	68	64	22, 19, 19, 18, 19.5, 19,	19.4
17273,	I.,	Feb. 20,	Feb. 22,	62	63	9.5, 9, 9.5, 9.5, 10, 10,	9.6
17274,	II.,	Feb. 20,	Feb. 22,	62	63	13, 13.5, 14, 14.5, 14, 13,	13.7
17275,	I.,	Feb. 22,	Feb. 25,	64	65	14.5, 15.5, 14, 14, 15, 15,	14.7
17276,	II.,	Feb. 22,	Feb. 25,	64	65	19, 19.5, 21, 22, 21.5, 21.5,	20.8
17277,	I.,	Feb. 27,	Mar. 1,	71	64	13, 13, 12, 12, 13, 14,	12.8
17278,	II.,	Feb. 27,	Mar. 1,	71	64	15.5, 16, 17, 16, 17.5, 17,	16.5

17279,	I.,	Mar. 1,	Mar. 4,	76	70	28, 29.5, 33, 32, 28, 27,	29.6
17280,	II.,	Mar. 1,	Mar. 4,	76	71	57, 58, 62, 58, 68, 50,	58.8
17281,	I.,	Mar. 6,	Mar. 8,	64	66	21, 18, 17, 17.5, 18.5, 22,	19.0
17282,	II.,	Mar. 6,	Mar. 8,	64	66	31, 33.5, 38, 28, 32, 35,	32.9
17283,	I.,	Mar. 8,	Mar. 11,	69	62	11.5, 12.0, 17.0, 12, 12, 13,	12.9
17284,	II.,	Mar. 8,	Mar. 11,	69	62	21, 17, 17, 17, 18, 21,	18.5
			Third Period.				
17525,	I.,	April 10,	April 15,	62	61	8, 8, 7.5, 8, 8, 8,	7.9
17526,	II.,	April 10,	April 15,	62	61	23, 23.5, 22, 21.5, 22.5, 22,	22.4
17527,	I.,	April 11,	April 15,	62	61	7, 7, 7, 7, 7, 7,	7.0
17528,	II.,	April 11,	April 15,	62	61	19, 19.5, 19.5, 19, 18, 18,	18.8
17529,	I.,	April 12,	April 15,	62	62	9.5, 9, 8, 8, 9, 8,	8.6
17530,	II.,	April 12,	April 15,	62	62	23.5, 24, 26, 23.5, 24.5, 23.5,	24.2
17531,	I.,	April 16,	April 22,	61	61	9, 9, 9, 8.5, 9, 10,	9.1
17532,	II.,	April 16,	April 22,	61	61	25, 28, 28, 29.5, 28, 27,	27.6
17533,	I.,	April 17,	April 22,	61	61	8.5, 8.5, 8.5, 9, 8, 9,	8.6
17534,	II.,	April 17,	April 22,	61	61	26, 30.5, 28, 26, 25.5, 27.5,	27.3
17535,	I.,	April 18,	April 22,	61	61	7.5, 8, 8, 8.5, 8, 8.5,	8.1
17536,	II.,	April 18,	April 22,	61	61	22, 23, 24.5, 25, 25, 26,	24.3
17537,	I.,	April 19,	April 22,	61	61	8, 8, 9, 9, 10, 10,	9.0
17538,	II.,	April 19,	April 22,	61	62	25, 25.5, 26, 27, 29, 26,	26.4
17539,	I.,	April 20,	April 22,	61	61	8.5, 9, 8.5, 9.5, 9, 10,	9.1
17540,	II.,	April 20,	April 22,	61	61	25, 27, 25, 28, 29, 27,	27.0

TABLE XVII. — *Average Degrees of Penetration (Millimeters).*

First Period (63° to 64.5° F.).		Second Period (64° to 66° F.).		Third Period (61° to 62° F.).	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
10.5	13.5	10.6	16.8	7.9	22.4
10.3	10.3	12.8	19.4	7.0	18.8
10.9	12.7	9.6	13.7	8.6	24.2
16.6	20.3	14.7	20.8	9.1	27.6
-	-	12.8	16.5	8.6	27.3
-	-	29.6[1]	58.8[1]	8.1	24.3
-	-	19.0	32.9	9.0	26.4
-	-	12.9	18.5	9.1	27.0
Averages 12.1	14.2	15.3	24.7	8.4	24.8

Table XVII. shows that the butter from Herd II. was a trifle softer in the first period than that produced by Herd I., and this condition, as has been stated, may be considered characteristic of the herd. In the second period the butter from Herd II. was noticeably softer than that from Herd I. (15.3° and 24.7°), a result due presumably to the oil in the soy bean meal, and perhaps partly to the soy bean protein. In the soy bean oil period the butter was tested at some 3° to 4° lower temperature than in the second period, hence the results from the two periods are not directly comparable. The data showed, however, that the butter produced by Herd II. in the last period was very much softer than from Herd I., due without doubt to the presence of so much soy bean oil in the ration. The penetration tests fully confirm the writer's personal observations, previously described.

[1] Temperature of butter, 70° to 71° F.

TABLE XVIII. — *Butter Scores and Observations (Gude Brothers).*

First period: both herds, normal grain ration.

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
35	35	25	25	15	15	10	10	5	5	90	90
38	34	25	25	15	15	10	10	5	5	93	89
34	34	25	25	15	15	10	10	5	5	89	89
36	36	25	25	15	15	10	10	5	5	91	91
Average, ...										91	90
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.											
35	38	24.5	25	15	15	10	10	5	5	89.5	93.0
35	35.5	24.5	24	15	15	10	10	5	5	89.5	89.5
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
Average, ...										89.5	91.0
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.											
33	33	25	24	15	15	10	10	5	5	88	87.0
33	33	25	24	15	15	10	10	5	5	88	87.0
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
35	35	24	25	15	15	10	10	5	5	89	90.0
36	38	25	25	15	15	10	10	5	5	91	93.0
36	37.5	25	25	15	15	10	10	5	5	91	92.5
36	37.5	25	25	15	15	10	10	5	5	91	92.5
Average, ...										90	90.0

The butter submitted to Gude Brothers of New York was scored by Mr. P. H. Kieffer. That produced in the first period he considered of reasonably good quality, noting no particular difference in the product of the two herds. He criticised it frequently as being greasy and having a tallowy odor.

The first two lots made in the second period he referred to as being of about the same quality as those produced in the first period. Samples sent from February 19 through March 7, completing the second period, all appeared to him to be of the same general character, and he did not give them any definite score, referring to them as "off in flavor," "having a pronounced tallowy and oily flavor," and not being of good grain. It did not seem possible for him to detect any differences that could be attributed to the influence of the food.

In the third period he noted the first few lots as having an oily and tallowy flavor, but seemed to think that the condition was not as pronounced towards the close of the period. Twice he criticised the body of the butter produced by Herd II. as being a trifle sticky or greasy.

The principal criticism of Mr. Kieffer consisted in his objection to the so-called lardy or tallowy flavor in place of the butter flavor in most of the samples. It was not possible for us to explain the cause of this condition, neither were we able to detect it in as pronounced a way as he. In the third period Mr. Kieffer did seem occasionally to note the softer body of the butter produced by Herd II., although apparently he did not consider it decidedly objectionable. Judging from his scores and from his general criticisms he noted no pronounced difference in the butter produced by the two herds, although he considered most of the lots sent him to be of second quality, particularly in flavor.

Table XIX. — *Butter Scores and Observations* (*Orrin Bent*).

First period: both herds, normal grain ration.

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
44	43.0	25	25	10	10	10	10	5	5	94	93.0
42	45.0	25	25	10	10	10	10	5	5	92	95.0
41	41.0	25	25	10	10	10	10	5	5	91	91.0
42	41.5	25	25	10	10	10	10	5	5	92	91.5
Average,										92	93.0

TABLE XIX. — *Butter Scores and Observations* (*Orrin Bent*) — Con.

Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
44	43	25	25	10	10	10	10	5	5	94	93
42	42	25	25	10	10	10	10	5	5	92	92
-	-	-	-	-	-	-	-	-	-	96	93
-	-	-	-	-	-	-	-	-	-	94	95
-	-	-	-	-	-	-	-	-	-	96	94
-	-	-	-	-	-	-	-	-	-	95	94
-	-	-	-	-	-	-	-	-	-	94	96
-	-	-	-	-	-	-	-	-	-	94	95
Average,										94	94

Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
44.0	43.0	25	23	10	10	10	10	5	5	94.0	91.0
44.0	42.0	25	23	10	10	10	10	5	5	94.0	90.0
45.0	43.0	25	25	10	10	10	10	5	5	95.0	93.0
45.0	42.0	25	25	10	10	10	10	5	5	95.0	92.0
45.0	43.0	25	23	10	10	10	10	5	5	95.0	91.0
44.0	43.0	25	23	10	10	10	10	5	5	94.0	91.0
46.5	47.5	25	25	10	10	10	10	5	5	96.5	97.5
46.5	47.5	25	25	10	10	10	10	5	5	96.5	97.5
Average,										95.0	92.9

Samples of butter were likewise submitted to Mr. Orrin Bent of Boston, who gave them very careful consideration, observing them on arrival and likewise after they had stood for a week. He scored noticeably higher than the New York party, and appeared, on the whole, to think more favorably of the butter. He occasionally noted the so-called oily condition in samples, but in no way made it as emphatic as did Mr. Kieffer. In the first two periods the product from each of the two herds was scored quite uniformly. In the third period Mr. Bent appeared to notice more than did Mr. Kieffer the soft body of the butter produced by Herd II., referred to it in his letters and marked it off frequently in body as well as in flavor.

TABLE XX. — *Churning Data A.*

First period: both herds, normal grain ration.

Date.	Milk (Pounds).		Cream (Pounds).		Fat in Cream (Per Cent.).		Fat in Cream (Pounds).		Fat in Skim Milk (Per Cent.).		Buttermilk (Pounds).		Fat in Buttermilk (Per Cent.).		Fat in Buttermilk (Pounds).	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
1907.																
Jan. 15, .	126.50	111.50	22.60	19.50	26.38	25.88	5.96	5.05	.020	.150	17.50	18.50	-	-	-	-
Jan. 17, .	128.00	114.00	24.00	23.00	26.63	25.00	6.39	5.75	.030	.040	16.00	17.00	.37	.31	.06	.05
Jan. 22, .	125.00	104.00	23.50	22.00	26.25	22.28	6.17	4.90	.030	.070	17.00	18.00	.23	.21	.04	.04
Jan. 24, .	122.50	119.00	23.00	22.00	26.88	23.75	6.18	5.23	.020	.040	16.00	18.50	.23	.25	.04	.05
Averages,	125.50	112.13	23.28	21.63	26.54	24.23	6.18	5.23	.025	.075	16.63	18.00	.28	.26	.05	.05
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.																
1908.																
Feb. 12, .	115.000	115.00	22.50	25.00	25.38	22.25	5.71	5.560	.01	.02	19.50	20.50	.23	.320	.040	.070
Feb. 14, .	119.000	116.25	24.00	22.75	24.25	23.00	5.82	5.230	.03	.31	19.00	19.00	.13	.050	.020	.010
Feb. 19, .	124.000	118.00	25.00	27.00	24.00	23.00	6.00	6.210	.04	.08	18.50	21.00	.14	.070	.030	.010
Feb. 21, .	117.000	121.00	25.00	25.50	25.38	23.13	6.35	5.900	.02	.04	19.50	17.50	.10	.090	.020	.020
Feb. 26, .	123.000	117.00	24.50	25.00	25.38	20.63	6.22	5.160	.07	.07	19.50	21.50	.13	.180	.030	.040
Feb. 28, .	120.500	116.00	25.50	25.75	23.50	21.50	5.99	5.540	.03	.03	21.75	22.25	.12	.100	.030	.020
Mar. 5, . .	116.500	113.25	25.00	25.00	22.75	21.00	5.69	5.250	.03	.03	19.75	19.25	.06	.190	.010	.040
Mar. 7, . .	118.000	113.50	24.00	23.50	21.88	19.00	5.25	4.470	.04	.07	18.75	18.75	.14	1.200	.030	.230
Averages,	119.125	116.25	24.44	24.94	24.07	21.69	5.88	5.415	.03	.08	19.53	19.97	.13	.275	.026	.055

Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.

1908.																		
Apr. 9-10, .	106.00	108.50	23.50	25.25	21.75	20.50	5.11	5.18	.07	.080	20.00	22.00	.13	.13	.03	.03
Apr. 10-11, .	117.00	100.75	25.00	22.25	23.88	21.38	5.97	4.76	.03	.030	19.00	19.50	.14	.26	.03	.05
Apr. 11-12, .	119.00	99.00	25.75	23.00	23.88	20.63	6.15	4.74	.08	.130	21.25	19.50	.90	1.10	.19	.21
Apr. 15-16, .	102.50	100.75	22.00	23.00	21.88	21.25	4.81	4.89	.05	.080	19.50	19.00	.07	.09	.01	.02
Apr. 16-17, .	102.25	105.50	21.75	23.75	22.63	21.38	4.92	5.08	.08	.043	19.00	20.50	.08	.12	.02	.02
Apr. 17-18, .	115.00	95.25	25.50	22.25	22.50	19.50	5.74	4.34	.07	.050	21.25	20.00	.10	.28	.02	.06
Apr. 18-19, .	110.50	88.50	24.00	20.50	23.75	20.75	5.70	4.25	.06	.160	20.00	18.50	.08	.16	.02	.03
Apr. 19-20, .	115.50	90.00	23.75	20.00	24.13	20.50	5.73	4.10	.07	.090	19.25	18.00	.09	.22	.02	.04
Averages,	110.97	98.53	23.91	22.50	23.05	20.74	5.52	4.67	.06	.083	19.91	19.63	.20	.30	.04	.06

Table XXI. — *Churning Data B.*

Date.	Kind of Starter. Herd I.	Kind of Starter. Herd II.	Per Cent. Starter. Herd I.	Per Cent. Starter. Herd II.	Temperature Ripening (Degrees F.). Herd I.	Temperature Ripening (Degrees F.). Herd II.	Time Ripening (Hours). Herd I.	Time Ripening (Hours). Herd II.	Acidity of Cream (Mann). Herd I.	Acidity of Cream (Mann). Herd II.	Time Churning (Minutes). Herd I.	Time Churning (Minutes). Herd II.	Temperature Churning (Degrees F.). Herd I.	Temperature Churning (Degrees F.). Herd II.	Temperature Buttermilk (Degrees F.). Herd I.	Temperature Buttermilk (Degrees F.). Herd II.	Temperature Wash Water (Degrees F.). Herd I.	Temperature Wash Water (Degrees F.). Herd II.
First period: both herds; normal grain ration.																		
Jan. 15,	Douglas,	Douglas,	10	10	70–72	70–71	22	22	26⅕	21⅕	67	72	57	57	60	60	58	58
Jan. 17,	Natural,	Natural,	–	–	70–75	70–75	46	46	28¾	35	43	40	57	56	64	64	60	60
Jan. 22,	Douglas,	Douglas,	15	15	70–72	70–72	23	23	32½	33¾	55	56	55	55	58	58	57	57
Jan. 24,	Douglas,	Douglas,	12	12	70–72	70–72	23	23	32	35	55	53	56	56	62	62	57	57
Second period: Herd I., normal grain ration; Herd II., soy bean meal ration.																		
Feb. 12,	Douglas,	Douglas,	15	15	70–75	70–77	–	–	37½	38¾	30	38	59	58	63	62	58	58
Feb. 14,	Douglas,	Douglas,	15	15	72	72	–	–	32½	35	25	17	58	58	62	60	58	58
Feb. 19,	Douglas,	Douglas,	15	15	65	65	22	22	33¾	36¼	90	90	56	56	56	56	56	56
Feb. 21,	Douglas,	Douglas,	15	15	63	63	22	22	33¾	38¾	31	31	58	58	58	58	58	58
Feb. 26,	Douglas,	Douglas,	15	15	64	63	22	22	33¾	40	24	30	62	62	62	62	60	60
Feb. 28,	Douglas,	Douglas,	15	15	64	63	22	22	36¼	36¼	28	25	61	61	61	61	60	60
Mar. 5,	Douglas,	Douglas,	15	15	64	64	22	22	36¾	38¼	20	20	62	60	62	60	60	60
Mar. 7,	Douglas,	Douglas,	15	15	64	64	22	22	35	37½	20	18	62	63	62	63	60	60
Third period: Herd I., normal grain ration; Herd II., soy bean oil ration.																		
Apr. 9,	Buttermilk,	Buttermilk,	10	10	61–64	61–64	33½	37½	33½	37½	54	49	59	59	62	62	60	60
Apr. 10,	Buttermilk,	Buttermilk,	10	10	61–63	61–63	34	35½	33¾	35½	29	34	62	62	64	64	60	60
Apr. 11,	Buttermilk,	Buttermilk,	10	10	62–64	62–64	32½	31½	32½	31½	66	40	63	63	66	65	62	62
Apr. 15,	Douglas,	Douglas,	15	15	62–64	62–64	38	40½	38	40½	36	32	60	60	64	64	61	61
Apr. 16,	Douglas,	Douglas,	15	15	62–70	61–68	35	38½	35	38½	40	77	58	57	62	64	59	59
Apr. 17,	Douglas,	Douglas,	15	15	61–64	61–64	35	36	35	36¼	33	38	62	62	65	66	62	62
Apr. 18,	Douglas,	Douglas,	15	15	62–64	62–64	19	19	36½	39¼	50	49	61	61	61	61	62	62
Apr. 19,	Douglas,	Douglas,	15	15	63–65	63–65	16½	16½	35½	38	21	35	62	63	64	64	62	62

TABLE XXII. — *Analyses of Feed Stuffs.*

Dry Matter Determinations (Per Cent.).

	Hay.	Normal Grain Ration.	Soy Bean Meal.
First period,	89.7	89.7	-
Second period,	89.7	90.3	92
Third period,	89.7	88.8	-

Composition of Feed Stuffs (Dry Matter).

	Hay (Per Cent.).	Normal Grain Ration (Per Cent.).	Soy Bean Meal [1] (Per Cent.).
Protein,	10.46	18.24	45.22
Fat,	2.69	5.28	9.34
Extract matter,	48.42	63.55	34.38
Fiber,	31.58	9.26	5.15
Ash,	6.85	4.17	5.91

Coefficients of Digestibility.

	Hay.	Normal Grain Ration.	Soy Bean Meal.
Protein,	57	78	91
Fat,	50	85	93
Extract matter,	61	72	81
Fiber,	60	32	-

CONCLUSIONS.

1. Soy bean meal partially extracted (2.3 pounds per day and head) seemed to be without influence in changing the proportions of the several milk constituents or in imparting any flavor to the milk.

2. Soy bean oil (.6 of a pound per day and head) was likewise without influence on the composition and flavor of the milk.

3. Soy bean meal did not modify the chemical character of the butter fat, neither did it have any effect upon the separation of the fat from the milk serum, the time of ripening of the cream nor on the thoroughness of the churning. Expert butter

[1] Partially extracted.

scorers could not detect any particular flavor in the butter as a result of feeding the meal. The meal imparted a noticeable softness to the body of the butter, but not sufficiently so as to injure its commercial value excepting during the warm months. The softness of the body of the butter was due probably to the oil contained in the bean meal and not to the bean protein.

4. Soy bean oil depressed the volatile fatty acids (Reichert-Meissl number) and thus lowered the saponification number of the butter fat; it increased the percentage of unsaturated acids (iodine number) and the total insoluble acids. The acid number and Valenta test were also increased. The oil did not noticeably change the melting point of the fat as measured by the Wiley test; it increased somewhat the refractive index.

5. The oil caused a marked softness of the butter; the latter also contained some 2 per cent. more moisture than did the butter produced by the normal ration. No other changes were observed.

SOY BEANS AND SOY BEAN OIL.

BY E. B. HOLLAND, M.SC.

1. Economic Uses.

The soy bean,[1] *Glycine hispida,* Moench, is a native of the Orient, where it is grown chiefly for its seed, which constitutes one of the staple products. J. J. Rein[2] states that in China and Japan the soy bean ranks first of leguminous crops in extent, variety of use and value, excelling all other vegetables in nutritive qualities, and when properly prepared second to none in flavor. While soy beans are eaten plain cooked, special foods prepared from them seem to be more generally used, prominent among which are several fermented products known as *shoyu,* an aromatic table sauce; *miso,* a thicker relish; and *natto,* a mush; also a bean curd or cheese called *tofu.* These preparations and others are described more fully by Rein,[2] C. F. Langworthy,[3] S. H. Angell,[4] Kellner,[5] M. Inoyue,[6] H. C. P. Geerligs[7] and Bloch.[8] Such products, rich in protein, prove a valuable adjunct to rice. Of the land under cultivation in Manchuria, from one-eighth to one-sixth, according to N. Ssemenow,[9] is devoted to the soy bean, and the production of an edible oil from the seeds forms one of the principal industries. Soy beans are considered too valuable in the east to be fed to horses or cattle, though the straw and sometimes the green fodder are used for that purpose.

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1 Japanese, Daidzu and O-mane.

2 The Industries of Japan, pp. 56–60, 62, 105–108.

3 U. S. Dept. Agr., Farmers' Bul. 58 (1897), pp. 20-23.

4 U. S. Cons. Rpts., Dec., 1897, pp. 551, 552.

5 Bul. Col. Agr., Tokyo Imp. Univ., 1, No. 6; Chem. Ztg. 19 (1895), pp. 97, 120, 265; Abs by H. Trimble, Amer. Jour. Pharm. 68 (1896), No. 6, pp. 311, 312.

6 Bul. Col. Agr., Tokyo Imp. Univ., 2, No. 4; Abs. Amer. Jour. Pharm.

7 Chem. Ztg. 20 (1896), No. 9, pp. 67–69; Abs. Exp. Sta. Rec., 8, p. 72.

8 Bul. Sci. Pharmacol., 13 (1906), pp. 138–143; Abs. Exp. Sta. Rec., 18, p. 857.

9 Abs. Exp. Sta. Rec., 15, pp. 669, 670.

It is rather uncertain when the soy bean was first introduced into the United States. The earliest references in experiment station literature would indicate between twenty and twenty-five years ago. C. A. Goessmann[1] reports growing two varieties on the station grounds in 1888. Of recent years the soy bean has been quite extensively cultivated for soiling (or pasturage) and silage purposes, and to a less extent for the production of commercial seed, for hay and as a green manure or cover crop. In Europe and America soy beans have been very little used as a human food. As they contain only a small amount of starch, sugar and dextrin, flour from the beans has been recommended by A. L. Winton[2] and Angell[3] for making bread and biscuits for people suffering from diabetes. Soy beans, dried and roasted, have been mentioned as a possible coffee substitute.[4]

2. The Chemistry of Soy Bean Meal.

The Massachusetts experiment station has given considerable attention to the soy bean as a forage crop, with particular reference to varieties, yield, composition, digestibility and general adaptability for dairy purposes. In addition to work of that character the station inaugurated, in the summer of 1898, a series of feeding experiments,[5] to note the effect of the different nutrient groups[6] — protein, fat and carbohydrates — in the various feeds on the composition of the milk and of the butter fat, and on the character of the butter. Fodder groups suitable for such work are usually obtained to the best advantage from the seeds or their manufactured products. The action of soy bean protein and of soy bean oil was under investigation during the winter of 1906–07.

The soy beans employed in the test were a mixture of several varieties, with medium green and southern yellow predominating. The analysis of the medium green will undoubtedly approximate that of the mixture.

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[1] Mass. State Exp. Sta. Rpt., 7 (1889), pp. 140, 141.

[2] Conn. State Exp. Sta. Rpt., 30 (1906), pp. 153–165.

[3] *Loco citato.*

[4] Agr. News (Barbados), 2 (1903), No. 36, p. 281; Abs. Exp. Sta. Rec., 15, p. 285; Langworthy in Farmers' Bul.

[5] Hatch Exp. Sta. Rpts., 13 (1901), pp. 14–33; 14 (1902), pp. 162–168; 16 (1904), pp. 45–62; Mass. Exp. Sta. Rpt., 21 (1909), pp. 66–110.

[6] It was thought this method would yield more definite information than could be learned from the influence of the combined groups.

Medium Green Soy Beans.

[Dry Matter.]

	Per Cent.
Ash,	5.46
Protein,	40.31
Fiber,	4.91
Nitrogen free extract,	27.68
Fat,	21.64

The above results are substantiated by those reported by Rein,[1] Langworthy[1] and W. O. Atwater,[2] showing the beans to be highly nitrogenous and to contain a large amount of oil. The protein of soy beans, according to the analyses of T. B. Osborne and G. F. Campbell,[3] consists (*a*) largely of glycinin, a globulin similar in properties to legumin but of somewhat different composition; (*b*) a small amount of a more soluble globulin, which resembles phaseolin in composition so far as could be ascertained in reactions; (*c*) 1.5 per cent. of legumelin, an albumen-like proteid; and (*d*) a small amount of proteose.

Winton[1] has shown that a sample of soy bean meal with a nitrogen free extract of 27.2 per cent. contained 9.7 per cent. of starch, sugar and dextrin expressed as starch.[4] Of the remainder, about 5 per cent. is pentosans[5] and 1 per cent. galactan,[6] leaving 11.5 per cent. undetermined. As glycinin, the chief proteid, contains 17.53 per cent. of nitrogen (factor 5.70 instead of 6.25) the undetermined extract matter should be even greater than appears. Kellner and Inoyue[1] deny the presence of any appreciable amount of starch, while Morawski and Stingl[7] claim the starch is converted by an active diastatic enzyme into sugar and dextrin. By precipitating an alcoholic extract of the beans with ether, Levallois[8] obtained a sugar which does not reduce Fehling solution, ferments readily with yeast and upon oxidization with nitric acid yields mucic and oxalic acid.

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1 *Loco citato.*
2 Conn. Storrs Exp. Sta. Rpt., 14 (1901), p. 178.
3 Conn. State Exp. Sta. Rpt., 21 (1897), pp. 374-382.
4 Determined by the diastase method, without previous washing.
5 Hatch Exp. Sta. Rpt., 15 (1903), p. 79.
6 Hatch Exp. Sta. Rpt., 9 (1897), p. 95.
7 Chem. Centbl., 1886, p. 724; Abs. Amer. Jour. Pharm.
8 Compt. Rend. Acad. Sci., Paris, 93, p. 281; Abs. Amer. Jour. Pharm.

3. Soy Bean Oil.

In order to study the effect of the protein and of the oil respectively it was necessary to extract the oil as thoroughly as possible, and to feed the cake and the oil in separate experiments. The extraction was carried out by the V. D. Anderson Company of Cleveland, O., who state[1] that the beans were rolled (not ground), heated to 100° to 150° F. (38° to 66° C.), and the oil removed by torsional pressure. They claim that heating at so low a temperature does not cook the product and thus prevents the liberation of glutinous matter. An analysis of the resulting cake indicates that from 55 to 60 per cent. of the oil was removed. The oil was passed through a filter press, fitted with cloth, but was not refined otherwise.

(a) *Physical Tests.*

The oil was clear and of a dark amber color, with an odor similar to that of other vegetable oils. As analytical data relative to soy bean oil is rather limited, it seemed advisable, for comparison and general information, to include most of the figures available. The specific gravity as recorded by different observers is stated below: —

Temperature (Degrees C.).	Specific Gravity.	Observer.
15	0.9206	E. B. Holland.
15	0.9242	De Negri and Fabris.[2]
15	0.9270	Morawski and Stingl.[2]
15	0.9240	Morawski and Stingl.[3]
15	0.9240	Shukoff.[1]
	0.9240[4]	

The result by the writer was obtained with a hydrometer, and is noticeably lower than the others. This is probably due to differences in method of oil production. Morawski and Stingl

[1] In correspondence with Dr. Lindsey.

[2] J. Lewkowitsch, Chemical Technology and Analysis of Oils, Fats and Waxes, third edition, Vol. II., pp. 506–508.

[3] Chem. Ztg., 1886, p. 140; Abs. Amer. Jour. Pharm.

[4] Average.

extracted at least part of the oil on which they worked with ether. A more accurate determination, by means of an ordinary picnometer, proved unsatisfactory at the low temperature desired because of the viscid nature of the material.

The specific viscosity was reported by F. W. Farrell[1] as 8.43, using a Boverton-Redwood viscosimeter. This indicates the rate of flow at 70° F., as compared with a like volume of water at the same temperature.

The refractive index N_D and mean dispersion $N_F - N_C$ were determined at several temperatures by an Abbé refractometer with a water jacket.

Temperature (Degrees C.).	Refractive Index.	Mean Dispersion.	Observer.
20	1.4749	.00938	E. B. Holland.
25	1.4730	.00934	E. B. Holland.
40	1.4675	.00922	E. B. Holland.

The Valenta test, or turbidity point of equal volumes of oil and glacial acetic acid, was 60° C. This test is based on solubility.

(b) *Chemical Tests.*

In the chemical examination of the oil the usual methods, with only slight modifications, were followed, unless otherwise stated, and they are too well known to need description.

Saponification (Koettstorfer) Number.	Acid Number.	Ether Number.	Observer.
191.95	1.27	190.68	E. B. Holland.
192.50	-	-	De Nigri and Fabris.
192.90	4.54[2]	188.36	Morawski and Stingl.
192.50	-	-	Morawski and Stingl.
190.60	-	-	Shukoff.
207.9-212.6[3]	-	-	W. Korentschewski and A. Zimmermann.[4]
192.13[5]			

[1] Of the Emerson Laboratory, Springfield, Mass.
[2] Calculated from an acidity of 2.28 per cent. as oleic acid.
[3] Excluded from the average.
[4] Vyestnik Obshch. Hig., Sudeb. i. Prakt. Med. 5 (1905), pp. 690-693; Abs. Exp. Sta. Rec., 18, p. 858.
[5] Average.

The saponification number of our sample agreed closely with the average. The acid number indicates a slight acidity, but this cannot be considered abnormal in an oil with such a high percentage of unsaturated acids if exposed to light and air for any length of time.

Where there is no appreciable amount of unsaponifiable matter, monoglycerides or diglycerides, additional data can be accurately calculated by formulæ[1] from the numbers just given. Of these, the Zulkowski formula for total fatty acids (T) from the ether number (e) is one of the most important.

$$T = 1 - .0002257\,e \text{ or } 95.70 \text{ per cent.}$$

If the saponification number of the fat (191.95) be divided by the per cent. of total fatty acids (95.70), the neutralization number (n) of the fatty acids is obtained (200.57), from which the mean molecular weight (m) can be determined as usual.

$$m = \frac{56158}{n} \text{ or } 279.99$$

Glycerol (G) can be calculated in a similar manner to the total fatty acids.

$$G = .0005465\,e \text{ or } 10.42 \text{ per cent.}$$

The acid number (a) can be converted into percentage of acidity (A), expressed as oleic or the acid of any other molecular weight.

$$A = \frac{282.272\,a}{56158} \text{ or } .63 \text{ per cent. as oleic acid.}$$

Employing the mean molecular weight (279.99) obtained above, the acidity would be the same. Neutral fat and unsaponifiable matter can be determined by difference, 100 less the percentage of acidity (.63), or 99.37 per cent.

The per cent. of acidity (A) can also be calculated from the acid number (a) and the neutralization number of the free fatty acids, or in case that has not been determined, from the

1 The derivation of these formulæ will be given in another article.

neutralization number of the total fatty acids (n). The substitution of the latter value will not always hold true.

$$A = \frac{a}{n} \text{ or } .63 \text{ per cent.}$$

The percentage of fatty acids (N) and glycerol (G) in the neutral fat (F) can be calculated by similar formulæ from the molecular weight (m) of the fatty acids of the neutral fats, or, less accurately, from the mean molecular weight of the total fatty acids.[1]

$$N = F \times \frac{3\ m}{3\,m + C_3H_2} = 95.07 \text{ per cent.}$$

The total fatty acids are equal to the sum of the fatty acids in the neutral fat (95.07) and the free fatty acids (.63), or 95.70, the same result previously obtained.

$$G = F \times \frac{92.064}{3\,m + C_3H_2} \text{ or } 10.42 \text{ per cent.}$$

The last three formulæ appear to have no greater merit than those first given and are rather more difficult to apply.

A direct determination of neutral fat and unsaponifiable matter gave the same results as the calulated.

Free fatty acids,	.63
Neutral fat and unsaponifiable matter,	99.37
Unsaponifiable matter,	.03
Neutral fat,	99.34

Briefly, the process consisted of treating 2 grams of oil with an excess of dry sodium carbonate in the presence of a small quantity of alcohol, stirring thoroughly. After the evaporation of the alcohol, quartz sand was added and the mixture transferred to an S. & S. capsule, extracted with dry ethyl ether in a continuous extractor and the dried extract considered neutral fat and unsaponifiable matter. The difference was free acids. The unsaponifiable matter was determined by saponifying 10 grams of oil with glycerol-soda, dissolving the resulting soap in warm water, filtering and washing. The dried residue was extracted

[1] In this case the molecular weights are the same, even to the second decimal, when the unsaponifiable matter is included in the neutral fat.

with ether, which dissolved the unsaponifiable matter. The amount was very small and presumably phytosterol. Morawski and Stingl[1] report .22 per cent. unsaponifiable matter.

The percentage of insoluble acids including unsaponifiable matter (Hehner number) is reported by only two analysts.

Insoluble Acids.	Neutralization Number.	Mean Molecular Weight.	Observer.
95.31	200.22	280.48	E. B. Holland.
95.50	–	–	Morawski and Stingl.
95.40[2]	–	–	–

Solidification of the insoluble acids was rather difficult, owing to the high percentage of liquid fatty acids, which Lane[1] reports as 80.26 per cent. The solid acids are said to be largely palmitic. The neutralization number and mean molecular weight agree closely with the calculated results for total fatty acids, and such should be the case in the absence of any appreciable amount of soluble acids.

The iodine number, as recorded by every observer, shows a high content of unsaturated acid.

Iodine Number.	Observer.	Iodine Number.	Observer.
130.77	E. B. Holland.	121.30	Morawski and Stingl.
121.30	De Nigri and Fabris.	124.00	Shukoff.
122.20	Morawski and Stingl.	123.90[2]	

The result obtained on the Massachusetts sample by Wijs' solution was somewhat higher than the others, indicating an oil of slightly different composition. The liquid acids are probably a mixture of oleic and linolic acids, as the high iodine number (130.77) is equivalent to 152 per cent. of olein, thus proving the presence of an unsaturated acid of a greater iodine absorption than oleic, — presumably linolic. Assuming that the total stated by Lane is reasonably accurate, the amount of each acid can be calculated by means of their theoretical absorption. Let x and y represent the percentages of oleic and linolic

1 From Lewkowitsch. 2 Average.

acids, with iodine numbers of 89.963 and 181.22, respectively, then: —

$$x + y = .8026$$
$$89.963\,x + 181.22\,y = 130.77$$
$$x = 16.08 \text{ per cent. oleic acid.}$$
$$y = 64.18 \text{ per cent. linolic acid.}$$

The above results indicate that there is approximately four parts of linolic to one part of oleic acid present.

The soluble fatty acids as determined by difference — total 95.70 less insoluble 95.31 — were .39 per cent. The Reichert-Meissl number was .19, which indicates a low volatile acid content, thus substantiating the previous result. In both cases the amount was insufficient to permit an accurate determination of the neutralization number and the mean molecular weight.

Soy bean oil is greatly affected by heat; if held at 100° C., for several hours the chromogenic bodies are destroyed and a noticeable percentage of the oil volatilized. Upon saponifying with glycerol-soda, the mixture takes on a dark red color, which fades as the soap sets.

According to the classification of Lewkowitsch, based on iodine number, soy bean oil is a semi-drying oil of the cotton-seed oil group. In composition it resembles cotton-seed, sesame and corn oils.

Our chemical data can be summarized as follows: —

Saponification number, . 191.95
Acid number, . . . 1.27
Ether number, . . . 190.68

99.37 per cent. neutral fat,[1] . { 95.07 per cent. fatty acids. / 10.42 per cent. glycerol.
.03 per cent. unsaponifiable matter.
.63 per cent. free fatty acids.

95.70 per cent. total fatty acids, . .
Neutralization number, 200.57, . .
Mean molecular weight, 279.99, . .
{
.39 per cent. soluble fatty acids.
.19 Reichert-Meissl number.
.11 per cent. volatile fatty acids.[2]
95.31 per cent. insoluble fatty acids,[1] . { palmitic acid. / oleic acid. / linolic acid.
Neutralization number, 200.22.
Mean molecular weight, 280.48.

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[1] The unsaponifiable matter is included in this percentage and in the resulting calculations.

[2] Calculated from the Reichert-Meissl number and the neutralization number of the total fatty acids.

METHODS FOR FAT ANALYSIS.

BY E. B. HOLLAND, M.SC.

During the past ten years the Massachusetts experiment station has conducted a series of feeding experiments, to ascertain, among other things, the effect of different concentrates upon the composition of the resulting butter fat. In connection with this work, which required a great many fat analyses, it was found necessary to study the methods thoroughly in order to simplify when possible, to bring to a like basis and above all to insure uniform results under known conditions of manipulation. The intent of this article is to give only the methods adopted, with a few supplementary notes. What originality there may be is reasonably evident if one compares the methods stated with those usually prescribed. It has been largely, however, the adapting of valuable suggestions from many careful analysts[1] though few references are cited.

Apparatus was one of the first things that required attention, especially flasks. A form and size were desired that would be suitable for all ordinary tests, and a 300 cubic centimeter Erlenmeyer flask, of uniform height and cork requirement, has satisfactorily filled that need. Such a flask occasionally calls for a slight increase in quantity of solvent, but that is to be expected. Normal graduated ware on the basis of the true cubic centimeter at 4° C. was adopted as the standard. The flasks are graduated for capacity and the burettes and pipettes for delivery at 20° C., and all graduations are verified.

The solutions are standardized at 20° C. and are brought to that temperature before being used. Tempering should be carefully observed, especially with alcoholic and acetic acid solutions having a high coefficient of expansion.

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[1] Allen, Brown, Blyth, Leach, Leffmann and Beam, Lewkowitsch, Prescott, Sadtler, Sherman, Wiley, Wright, Zulkowski and others.

The methods that follow will be treated under the following headings: —

1. Saponification (Koettstorfer) number.
2. Acid number.
3. Ether (ester) number.
4. Calculated data from saponification, acid and ether numbers.
5. Reichert-Meissl number.
   (*a*) Mean molecular weight.
   (*b*) Neutralization number.
6. Soluble fatty acids.
   (*a*) Neutralization number.
   (*b*) Mean molecular weight.
7. Insoluble fatty acids and unsaponifiable matter.
   (*a*) Neutralization number.
   (*b*) Mean molecular weight.
   (*c*) Iodine number.
8. Calculated data from the fatty acids.
9. Iodine number.
10. Calculated data from the iodine number.
11. Neutral fat and unsaponifiable matter.
12. Unsaponifiable matter.

1. Saponification (Koettstorfer) Number.

The saponification number indicates the milligrams of potassium hydrate required for the complete saponification of 1 gram of an oil, fat or wax.

Reagents. — Alcoholic potash solution, 40 grams of potassium hydrate, free from carbonate, to 1,000 cubic centimeters of 95 per cent. alcohol,[1] free from acid and aldehyde. The solution should be allowed to stand at least twenty-four hours and filtered immediately before use.

Ninety-five per cent. alcohol, free from acid and aldehyde.

N/2 hydrochloric acid solution.

Phenolphthalein solution, 1 gram to 100 cubic centimeters of alcohol, neutralized.

Method. — Into a 300 cubic centimeter Erlenmeyer flask are

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[1] All alcohol used as a solvent in fat analysis or in preparation of the reagents should be treated several days with caustic lime and redistilled. This insures the removal of acid, aldehyde and a portion of the water. The distillate should be preserved in glass and protected from direct sunlight. Such alcohol permits of a more distinct end reaction in titration. A very dry alcohol sometimes requires the addition of a small quantity of water in the preparation of alcoholic potash.

brought 5 grams of fat together with 50 cubic centimeters of alcoholic potash, accurately measured with a burette, and 50 cubic centimeters of alcohol. The flask is connected with a condensing tube and heated on asbestos board at low ebullition until saponification is complete, about thirty minutes. When cool, the solution is titrated with N/2 hydrochloric acid, using a few drops of phenolphthalein as indicator. The temperature of the solution during titration should be adequate to maintain the soap in solution but not to greatly exceed that requirement. Absorption of carbonic acid from the air should be carefully guarded against at all times, especially during the process of cooling. Several blank determinations should be conducted with every series of tests. The difference between the acid titration of the blank and of the test gives the alkali required by the fat.

One cubic centimeter of N/2 acid is equivalent to 28.079 milligrams of potassium hydrate.

Limit of error, .50 saponification number.

Synopsis of Reaction.

$$\underset{\text{fat}}{C_3H_5(RO_2)_3} + \underset{\text{alkali}}{3\ KOH} = \underset{\text{salt}}{3\ RO_2K} + \underset{\text{glycerol.}}{C_3H_5(OH)_3}$$

Titration of excess alkali.

R in the graphic formula of the fatty acids represents C and H in different amounts, according to the acid, but usually in the proportion of C_nH_{2n-1}, except in the case of unsaturated acids.

Supplementary Notes. — The term "saponification or saturation equivalent," as employed by Allen and others, indicates the grams of fat that are saponifiable with one equivalent of potassium hydrate in grams (56.158). In other words, the grams of fat saponifiable with 1 liter of N/1 potassium hydrate.

$$\text{Saponification equivalent } (s_1) = \frac{56158}{s} \text{ or } \frac{\text{mg. of fat}}{\text{c.c. N/1 alkali}}$$

$$\text{Saponification number } (s) = \frac{56158}{s_1}$$

The lower the molecular weight of the fatty acids (or esters) the more alkali will be required to satisfy 1 gram, and the

higher will be the saponification number. Fats and oils containing a considerable amount of the glycerides of the lower (volatile) fatty acids are characterized by a saponification number exceeding 200.

2. Acid Number.

The acid number indicates the milligrams of potassium hydrate required to neutralize the free fatty acids in 1 gram of an oil, fat or wax.

Reagents. — Ninety-five per cent. alcohol, free from acid and aldehyde.

N/10 potassium (or sodium) hydrate solution.

Phenolphthalein solution, 1 gram to 100 cubic centimeters of alcohol, neutralized.

Method. — Ten grams of fat are brought into a 300 cubic centimeter Erlenmeyer flask together with 100 cubic centimeters of alcohol. The flask is connected with a condensing tube and heated on asbestos board at low ebullition for five minutes to insure solution of the free fatty acids. When cool the solution is titrated[1] with N/10 alkali, using a few drops of phenolphthalein as indicator. The pink coloration will not remain permanent because of the saponification of neutral esters and the decolorizing action of the carbonic acid absorbed from the air on shaking. Allowing the solution to cool, however, previous to titration will practically prevent saponification. The indicator also appears more sensitive to cool than to hot solutions. Undue shaking should be avoided. Several blank determinations should be run on the alcohol with every series of tests and deducted. A purified alcohol should be nearly neutral, or it can be readily made so, if desired, before being used.

One cubic centimeter of N/10 alkali is equivalent to 5.6158 milligrams of potassium hydrate.

Limit of error, .10 acid number.

Synopsis of Reaction. — Solution of free fatty acids in alcohol.

$$3\ RO_2H + 3\ KOH = 3\ RO_2K + 3\ H_2O$$

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[1] Note directions relative to titrating saponification number of fat and neutralization number of insoluble acids.

Supplementary Notes. — Koettstorfer expresses the acidity by the cubic centimeter of N / 1 potassium hydrate required for 100 grams of fat as "degrees of acidity." Stockmeier reports "degrees of rancidity" in the same manner. N/10 alkali and 10 grams of fat are, however, more convenient quantities with which to work.

$$1^\circ \text{ rancidity} = \ .56158 \text{ acid number.}$$
$$1^\circ \text{ acid number} = 1.78069^\circ \text{ rancidity.}$$

Rosaniline develops with free fatty acids a red color due to the formation of rosaniline oleate, and is known as the Jacobsen test.

The acid number of oils and fats varies with the purity, age and the amount of hydrolysis and of oxidation they have undergone. Contact with fermenting or decaying matter tends to rapidly increase the amount. Rancidity develops more readily in liquid oils in which olein predominates than in the solid fats, which are composed more largely of palmitin and stearin. Fresh animal fats are practically free from acid, while vegetable oils seem to contain a small amount.

3. Ether (Ester) Number.

The ether number indicates the milligrams of potassium hydrate required for the saponification of the neutral esters in 1 gram of an oil, fat or wax.

The ether number is represented by the difference between the saponification and acid numbers, and in cases where there are no free fatty acids present, is identical with the saponification number.

Supplementary Notes. — Natural fats, both animal and vegetable, contain practically only triglycerides, — neutral glycyl esters. These glycerides may occur, however, to some extent as complex molecules instead of simple.

Lewkowitsch asserts that the presence of free fatty acids indicates previous hydrolysis of the triglycerides, and hydrolysis conditions the presence of monoglycerides and diglycerides, therefore the so-called ether number loses its definite character as free acids increase.

4. Calculated Data from Saponification, Acid and Ether Numbers.

Glycerol. — In the saponification of any triglyceride, 3 molecules or 168.474 parts of potassium hydrate combine with 1 molecule of fat, setting free 1 molecule or 92.064 parts of glycerol, therefore 1 gram of potassium hydrate is equal to .5465 of a gram of glycerol.

$$\underset{\text{fat}}{C_3H_5(RO_2)_3} + \underset{\text{alkali}}{3\ KOH} = \underset{\text{glycerol}}{C_3H_5(OH)_3} + \underset{\text{salt}}{3\ RO_2K.}$$

The percentage of glycerol (G) can be calculated from the ether number (e) by means of the formula: —

$$G = .0005465\ e. \quad (1)$$

This method is not applicable in the case of fats containing monoglycerides and diglycerides, aldehyde bodies or appreciable amounts of unsaponifiable matter.

Total Fatty Acids. — In the saponification of a fat, 3 molecules or 54.058 parts of water are required for every molecule or 92.064 parts of glycerol separated.

$$\underset{1}{C_3H_5(RO_2)_3} + \underset{54.048}{3\ H_2O} = \underset{92.064}{C_3H_5(OH)_3} + \underset{-}{3\ RO_2H.}$$

The percentage of total fatty acids (T) in 1 part of fat can be calculated from the percentage of glycerol (G) by means of the formula: —

$$T = 1 + \frac{54.048}{92.064} G - G \text{ or } 1 - \frac{38.016}{92.064} G$$

and substituting the value of glycerol in terms of ether number (e): —

$$T = 1 - \frac{38.016}{92.064} \times .0005465\ e \text{ or } 1 - .0002257\ e. \quad (2)$$

Neutralization Number and Mean Molecular Weight of Total Fatty Acids. — The neutralization number (n) and mean molecular weight (m) of the total fatty acids can be calculated

from the ether (e) and saponification (s) numbers by means of the formulæ: —

$$n = \frac{s}{1 - .0002257\ e} \quad (3)$$

$$m = \frac{56158}{n} \quad (4)$$

Mean Molecular Weight of Fatty Acids in Neutral Fat. — The molecular weight (m) of the acids in the neutral fat can be calculated from the ether number (e) and the percentage of neutral fat (F) — determined either gravimetrically or by difference[1] — by the formula: —

$$m = \frac{3 \times 56158 \times F}{e} \text{ or } \frac{168474\ F}{e}$$

$$m = 3(m - H) + C_3H_5 \text{ or } 3(m - 1.008) + 41.04 \text{ or } 3\ m + 38.016$$

$$3\ m + 38.016 = \frac{168474\ F}{e}$$

$$m = \frac{56158\ F}{e} - 12.672 \quad (5)$$

Fatty Acids in Neutral Fat. — The fatty acids (N) in neutral fat can be calculated from the percentage of neutral fat (F) and the mean molecular weight (m) of the fatty acids in the neutral fat:[2] —

$$N = F \times \frac{3\ m}{3\ m + C_3H_2} \quad (6)$$

The total fatty acids are equal to the sum of the fatty acids in the neutral fat and the free fatty acids.

Glycerol. — The glycerol (G) can be calculated in a manner similar to the fatty acids in the neutral fat.

$$G = F \times \frac{92.064}{3\ m + 38.016} \quad (7)$$

Free Fatty Acids. — The acid number (a) can be readily converted into percentage of free fatty acids (A) expressed as oleic,

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[1] The unsaponifiable matter is a source of error.

[2] A close approximation can usually be obtained by using the mean molecular weight of the total fatty acids.

as an assumed acid with a molecular weight determined by formula (4), or as the acid of any other molecular weight.

$$A = \frac{a \times m}{56158} \quad (8)$$

When the free acid is known or the predominant acid is a mixture, it is often desirable to report acidity in terms of that acid. In such cases it is preferable to calculate the percentage directly from the titration by factor .0001 of the molecular weight of the acid (mono basic) for an N/10 solution, or .001 for N/1.

The per cent. of acidity (A) can also be calculated from the acid number (a) and the neutralization number (n) of the total fatty acids.[1]

$$A = \frac{a}{n} \quad (9)$$

Neutral Fat and Unsaponifiable Matter. — The neutral fat and unsaponifiable matter can be determined by difference, — 100 less per cent. of free fatty acids.

5. Reichert-Meissl Number.

The Reichert-Meissl number[2] indicates the cubic centimeters of N/10 potassium hydrate solution required to neutralize that portion of the volatile fatty acids which is obtained from 5 grams of an oil, fat or wax by the Reichert distillation process.

Leffmann-Beam Modification.

Reagents. — Glycerol-soda solution, 100 cubic centimeters of sodium hydrate solution (equal parts of soda and water filtered), free from carbonate, to 900 cubic centimeters of pure glycerol.

Sulfuric acid solution, 1 to 4.

N/10 potassium (or sodium) hydrate solution.

Phenolphthalein solution, 1 gram to 100 cubic centimeters of alcohol, neutralized.

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[1] Strictly it should be the neutralization number of the free fatty acids. The number of cubic centimeters of N/1 alkali required can be substituted in place of the values a and n.

[2] The Reichert number is that obtained from 2.5 grams of fat, and the proportion of acids volatilized is somewhat greater than with 5 grams, Reichert-Meissl number.

Pumice stone; the stone is prepared by dropping it at white heat into distilled water and leaving it until required.

Method. — Into an Erlenmeyer flask of 300 cubic centimeters capacity are brought 5 grams of fat, carefully avoiding getting any fat on the sides of the flask; 20 cubic centimeters of glycerol-soda are added and heated over a naked flame, rotating continuously, until the saponification is complete, as shown by the mixture becoming perfectly clear. The soap when cold should be white and free from globules of fat. Many small pieces of pumice stone, 135 cubic centimeters of recently boiled distilled water and 5 cubic centimeters of sulfuric acid solution are added, and the flask connected with a Liebig condenser[1] and heated carefully on gauze until a transparent oily layer of insoluble fatty acids forms on the surface; 110 cubic centimeters are then distilled over in as near thirty minutes as possible and received in a sugar flask. The distillate is passed through a dry dense filter, to remove all traces of the higher fatty acids which may have passed over with the volatile acids and appear in the distillate as oily drops or white solid particles. After mixing thoroughly, 100 cubic centimeters are pipetted into a small flask and titrated with N/10 alkali, using 5 drops[2] of phenolphthalein as indicator, avoiding entirely the addition of water. The pink coloration should hold at least five minutes. Extreme care should be exercised in preventing the absorption of carbonic acid at all times during the process. Blank tests should be conducted with every new lot of reagents. The titration reading, minus the blank, increased by a tenth and calculated to exactly a 5-gram basis, represents the Reichert-Meissl number.

Limit of error, .25 Reichert-Meissl number.

Synopsis of Reaction.

$$\underset{\text{fat}}{C_3H_5(RO_2)_3} + \underset{\text{alkali}}{3\ NaOH} = \underset{\text{salt}}{3\ RO_2Na} + \underset{\text{glycerol}}{C_3H_5(OH)_3}$$

The added glycerol acts as a transmitter of heat and has a boiling point of 290° C.

$$2\ RO_2Na + H_2SO_4 = 2\ RO_2H + Na_2SO_4.$$

Titration of the volatile acids.

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[1] A vertical condenser with a rapid circulation of cold water is advisable.

[2] A definite quantity is necessary if the mean molecular weight is to be determined.

Supplementary Notes. — As this method is only an arbitrary one it is essential to adhere strictly to the conditions of operation as laid down if comparative results are to be obtained, and by so doing over 90 per cent. of the soluble acids in butter can be secured in the distillate. Repeated distillation yields higher results, but is accompanied by decomposition of non-volatile acids.

Butyric, caprivic, caprylic and capric are the only fatty acids that can be distilled under ordinary pressure without decomposition. Lauric is almost insoluble in water but is volatile in a current of steam.

Most of the natural fats and oils contain but a small amount of volatile (soluble) fatty acids, generally below 1 Reichert-Meissl number. Among the prominent exceptions are butter fat and porpoise, dolphin, croton, cocoanut and palm nut oils.

(*a*) *Mean Molecular Weight.*

The titrated volatile acids[1] resulting from the determination of the Reichert-Meissel number are evaporated in a tared platinum dish and dried to constant weight in an air bath at 100° C. From the weight of the salts and of the alkali present in them the mean molecular weight (m) can be readily calculated by the following formula: —

$$m = \frac{40.058\ [\text{salts} - (\text{c.c. N/10 NaOH} \times .0040058)]}{\text{c.c. N/10 NaOH} \times .0040058} + 18.016$$

$$m = \frac{10000\ [\text{salts} - (\text{c.c. N/10 NaOH} \times .0040058)]}{\text{c.c. N/10 NaOH}} + 18.016$$

Blank determinations should be run with every new lot of reagents, both by distillation (Reichert-Meissl number) and by evaporation of the titrated portion (salts), and deducted in the calculation. To check the N/10 solution a definite quantity should be evaporated with an excess of sulfuric acid and calcined. If the weight obtained is greater than the alkali converted to sulfate, due to impurities, the factor .0040058 should be increased sufficiently to offset it.

Limit of error, 1 molecular weight.

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[1] Using N/10 sodium hydrate, prepared from caustic alkali made from metallic sodium so as to insure freedom from impurities.

(*b*) *Neutralization Number.*

The neutralization number (n) of the volatile fatty acids can be readily calculated from the mean molecular weight (m) by means of the formula: —

$$n = \frac{56158}{m}$$

6. Soluble Fatty Acids.

The soluble fatty acids indicate the percentage of fatty acids in an oil, fat or wax that is soluble in water.[1] The percentage of soluble fatty acids can be readily calculated by difference, — total fatty acids less the insoluble.

(*a*) *Neutralization Number.*

The neutralization number indicates the milligrams of potassium hydrate required to saturate 1 gram of soluble fatty acids. The difference between the saponification number of the fat and the product of the percentage of insoluble fatty acids times their neutralization number indicates the milligrams of potassium hydrate required to neutralize the soluble fatty acids in 1 gram of fat, which, divided by the percentage of soluble fatty acids, gives the neutralization number of the soluble fatty acids.

(*b*) *Mean Molecular Weight.*

The molecular weight (m) of the soluble fatty acids can be calculated from the neutralization number (n) by means of the formula: —

$$m = \frac{56158}{n}$$

7. Insoluble Fatty Acids and Unsaponifiable Matter (Hehner Number).

The Hehner number indicates the percentage of insoluble fatty acids and unsaponifiable matter in an oil, fat or wax.

Reagents. — Glycerol-soda solution, 100 cubic centimeters of sodium hydrate solution (equal parts of soda and water fil-

[1] This may mean either hot or cold water, according to the method employed.

tered), free from carbonate, to 900 cubic centimeters of pure glycerol.

Hydrochloric acid solution of a strength that approximately 45 cubic centimeters will neutralize 20 cubic centimeters of the glycerol-soda solution.

Ether.

Method. — Into a tared 300 cubic centimeter Erlenmeyer flask are brought 5 grams of fat together with 20 cubic centimeters of glycerol-soda solution, and heated over a naked flame, rotating continuously, until the saponification is complete, as shown by the mixture becoming perfectly clear. Care should be taken not to overheat and discolor the fat. Fifty cubic centimeters of hydrochloric acid solution are now added and the flask loosely stoppered[1], heated on a water bath, rotating occasionally, until the separated fatty acids form a transparent oily layer on the upper surface of the clear liquid. This requires several hours and must not be shirked. The flask and contents are cooled in ice water, and after the fatty acids solidify the solution is decanted through a fat-free filter, using care not to break the insoluble cake; 150 cubic centimeters of hot water are added, thoroughly agitated, and heated as above, cooled, and the solution filtered. This process is continued until the washings are free from acid, about six times. The flask containing the cake of insoluble fatty acids is inverted and allowed to stand in a cool place over night and drain. A convenient filter stand for both filtration and draining is illustrated by Wiley.[2] The next day the small particles of fat adhering to the filter are dissolved in the least possible amount of ether and the solution run into the flask. The ether is driven off in a water bath below 70° C., and the insoluble acids dried in an air bath at 100° C. The final drying period should not exceed two hours.

There are two compensating errors that usually result from this method, which are volatilization of fatty acids and oxidization of unsaturated acids. The latter is especially serious, and may render of questionable value a determination of the iodine

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[1] A condenser is necessary if the soluble acids are to be determined directly.

[2] Foods and Food Adulterants, United States Department of Agriculture, Bureau of Chemistry, Bulletin No. 13, p. 457.

absorption of the insoluble acids. Drying in a vacuum oven below 70° C., in a current of carbonic acid gas or in a vacuum desiccator will practically prevent oxidization as well as volatilization.

Limit of error, .25 per cent. insoluble acids.

Synopsis of Reaction. — Similar to those of the Reichert-Meissl number.

Supplementary Notes. — Most fats and oils contain from 95 to 97 per cent. of insoluble acids. Some notable exceptions are stated under the Reichert-Meissl number.

(a) *Neutralization Number.*

The neutralization number indicates the milligrams of potassium hydrate required to saturate 1 gram of insoluble fatty acids.

Reagents. — Ninety-five per cent. alcohol, free from acid and aldehyde.

N/2 potassium (or sodium) hydrate solution.

Phenolphthalein solution, 1 gram to 100 cubic centimeters of alcohol, neutralized.

Method. — The dried insoluble fatty acids resulting from the determination of the Hehner number are treated with 100 cubic centimeters of alcohol, connected with a condensing tube and heated on asbestos board at low ebullition until the solution is complete, about five minutes. When cool the solution is titrated with N/2 alkali, using a few drops of phenolphthalein as indicator. The temperature during titration should be sufficient to retain the fatty acids in solution but not greatly in excess. Blank determinations should be run on the alcohol with every series of tests and deducted. If preferred, the alcohol can be neutralized previous to its use.

One cubic centimeter N/2 alkali is equivalent to 28.079 milligrams of potassium hydrate.

Limit of error, 1 neutralization number.

Synopsis of Reaction. — See Acid number.

(b) *Mean Molecular Weight.*

The molecular weight (m) of the insoluble fatty acids can be calculated from the neutralization number (n) by means of the formula: —

$$m = \frac{56158}{n} \text{ or } \frac{2000 \times \text{wt. of acids}}{\text{c.c. N/2 alkali}}.$$

(c) *Iodine Number.*

The iodine number indicates the percentage of iodine chloride absorbed by the insoluble fatty acids, expressed in terms of iodine.

The same process, on a weighed amount of insoluble fatty acids, is followed as in the case of an oil or fat. Particular attention should be paid to the separation and drying of the insoluble fatty acids, so as to prevent oxidization of the unsaturated acids.

8. Calculated Data from the Fatty Acids.

Glycerides. — The percentage of triglyceride (Gl) can be calculated from the percentage of any fatty acid (A) by means of the molecular weight (m) of the fatty acid.

$$Gl = \frac{3\text{ m} + C_3H_2}{3\text{ m}} \times A.$$

From the above formula the following factors were deduced for the acids enumerated below: —

Lauric acid,	$C_{12}H_{24}O_2$, ...	1.0632
Myristic acid,	$C_{14}H_{28}O_2$, ...	1.0555
Palmitic acid,	$C_{16}H_{32}O_2$, ...	1.0495
Stearic acid,	$C_{18}H_{36}O_2$, ...	1.0446
Oleic acid,	$C_{18}H_{34}O_2$, ...	1.0449
Linolic acid,	$C_{18}H_{32}O_2$, ...	1.0452

9. Iodine Number.

The iodine number indicates the percentage of iodine chloride absorbed by an oil, fat or wax, expressed in terms of iodine.

Hubl Method (Wijs' Solution).

Reagents. — Carbon tetrachloride, dry and free from oxidizable products.

Iodine solution according to Wijs[1]: 13 grams of resublimated iodine to 1,000 cubic centimeters of glacial acetic acid (99.5 per cent.), free from oxidizable products. After the iodine is completely dissolved the solution is treated with pure dry chlorine gas[2] until the iodine has been converted into monochloride. The completion of the reaction is indicated by a distinct change, the solution becoming transparent, cherry red, and the titer with thiosulfate doubled. As it is desirable to have a slight excess of iodine it is advisable to retain a small quantity of untreated solution to add in case of necessity.

N/10 sodium thiosulfate (hyposulfite) solution: 24.830 grams of sodium thiosulfate are dissolved in water and made up to a liter at 20° C.

Potassium bichromate solution: 3.8657 grams of dry potassium bichromate, free from sodium bichromate, are dissolved in water and made up to a liter at 20° C. This solution will keep indefinitely, without changing, and is used for standardizing the thiosulfate solution; 100 cubic centimeters of potassium bichromate solution will liberate 1 gram of iodine from a potassium iodide solution.

Potassium iodide solution: 165 grams of neutral potassium iodide, free from iodine and iodate, to 1,000 cubic centimeters of water. Iodate is said to be frequently present in commercial potassium iodide and yields free iodine with hydrochloric acid.

Starch paste: 1 gram to 200 cubic centimeters of water. The solution is prepared by boiling ten minutes.

Process of Standardizing the Thiosulfate Solution. — Twenty cubic centimeters of potassium bichromate solution are accurately measured into a 300 cubic centimeter Erlenmeyer flask and 10 cubic centimeters of potassium iodide solution and 5 cubic centimeters of concentrated hydrochloric acid added. Thiosulfate solution is run in gradually until the brownish yellow

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[1] Wijs' solution, with the same active reagent (iodine monochloride), has largely replaced that of Hubl because of its far greater stability and more rapid absorption.

[2] Well washed, and then dried by being passed through concentrated sulfuric acid.

color (iodine) has been largely destroyed, then 2 cubic centimeters of starch paste are added and the titration continued until the blue particles have entirely disappeared from the resulting bright green solution. As five times the titration is equivalent to 1 gram of iodine, the iodine value of 1 cubic centimeter of thiosulfate is easily calculated.

In theory, 1 cubic centimeter N/10 $Na_2S_2O_3$ 5 aq. is equivalent to .012697 of a gram of iodine.

The following is the reaction: —

$$K_2Cr_2O_7 + 14\ HCl + 6\ KI = 2\ CrCl_3 + 8\ KCl + 6\ I + 7\ H_2O$$
$$6\ I : K_2Cr_2O_7 :: 1 : x.$$
$$761.82 : 294.50 :: 1 : .38657 \text{ g. in a 100 c.c.}$$

Method. — One gram of fat (.2 of a gram of a drying or fish oil, .3 of a gram of a semidrying oil, or .4 of a gram of nondrying oil) is brought into a 300 cubic centimeter Erlenmeyer flask and 10 cubic centimeters of carbon tetrachloride added. After complete solution, 30 cubic centimeters of iodine solution, accurately measured with a burette, are added and the flask well stoppered and allowed to stand two hours[1] in a cool, dark place, with occasional shaking. A rapid bleaching of the solution indicates insufficient iodine. A considerable excess is said to be necessary for the attainment of constant results. The temperature should not exceed 20° C., as heat seems to cause a secondary reaction and certainly destroys the accuracy of the determination. Moistening of the stopper with potassium iodide solution will prevent loss of iodine by volatilization. At the end of the absorption period 100 cubic centimeters of cold, recently boiled distilled water and 10 cubic centimeters of potassium iodide solution are added to the contents of the flask, and the excess of iodine titrated with sodium thiosulfate solution. The thiosulfate is run in gradually, with constant shaking, until the brownish yellow color of the solution has been largely destroyed, then 2 cubic centimeters of starch paste are added and the titration continued until the blue particles have entirely disappeared. Towards the end of the reaction the flask should be stoppered and shaken violently, so that any iodine in the carbon tetra-

[1] According to Wijs, one hour is sufficient for any oil or fat and fifteen to thirty minutes for nondrying and semidrying oils.

chloride will be taken up by the potassium iodide. The "bleached" condition should hold for at least five minutes, though the blue color may develop again in time, due to the splitting off of iodine. Several blank determinations should be run with every series of tests. The difference between the titration of the blank and that of the excess iodine is the thiosulfate equivalent of the fat, which multiplied by the factor (obtained as above) and divided by the weight of fat gives the percentage of iodine absorbed.

Limit of error, .25 iodine number.

Synopsis of Reaction. — Solution with carbon tetrachloride.

Formation of chloro-iodo additive compounds with unsaturated acids and their glycerides.

Solution of the excess iodine with potassium iodide and titration with sodium thiosulfate, using starch paste as indicator.

$$2\ Na_2S_2O_3 + 2\ I = Na_2S_4O_6 + 2\ NaI.$$

10. Calculated Data from the Iodine Number.

Theoretically the unsaturated fatty acids belonging to the oleic and ricinoleic series absorb 2 atoms of the halogen, linolic series 4 atoms, linolenic series 6 atoms, etc. The glycerides act similarly to the free acids and absorb three times as many atoms (triglycerides). In fats and nondrying oils olein is the prominent unsaturated glyceride and linolein in drying oils. In those cases where only one such acid or glyceride is present its percentage can be readily calculated from the iodine number, dividing by the theoretical absorption.

$$\text{Oleic acid} = \frac{2\ I}{C_{18}\ H_{34}\ O_2} = \frac{2 \times 126.97}{282.272} = .89963$$

$$\text{Olein} = \frac{6\ I}{C_3H_5(C_{18}\ H_{33}\ O_2)_3{}^1} = \frac{761.82}{884.822} = .86098$$

In a similar manner linolic acid combines with 1.81220 parts of iodine and linolein with 1.73380.

Where there are two unsaturated acids (or glycerides) present (x and y) of known absorption (c and d), if the percentage of the mixture (P) and the iodine number (I) of the fat have

[1] $3(C_{18}H_{34}O_2) + C_3H_2$.

been determined, the per cent. of each acid (or glycerides) can be calculated by formula: —

$$x + y = P$$
$$cx + dy = .01\ I\ [2]$$
$$x = \frac{.01\ I - dP}{c - d}$$

11. Neutral Fat and Unsaponifiable Matter.

The neutral fat and unsaponifiable matter indicates the percentage of these substances in an oil, fat or wax.

Reagents. — Sodium carbonate, anhydrous powder, free from caustic alkali.

Ethyl ether, anhydrous and free from alcohol.

Method. — Into a 3-inch porcelain dish are brought 2 grams of fat together with 1 gram of sodium carbonate and 5 cubic centimeters of alcohol, and the contents stirred thoroughly. After evaporation of the alcohol 25 grams of quartz sand are added, and the mixture transferred to a S. & S. capsule and extracted with ether in a continuous extractor. The extract is dried for one hour in an air bath at 100° C., and considered neutral fat and unsaponifiable matter. Drying[1] in a vacuum oven below 70° C. is preferable. Unnecessary heating should be avoided, as it causes oxidization and sometimes volatilization.

Limit of error, .15 per cent.

Synopsis of Reaction. — Neutralization of free fatty acids with sodium carbonate.

Extraction of neutral fat and unsaponifiable matter with ether.

Free Fatty Acids. — Free fatty acids can be determined by difference, — 100 less per cent. of neutral fat and unsaponifiable matter.

12. Unsaponifiable Matter.

The unsaponifiable matter of an oil, fat or wax is that portion which does not combine with caustic alkali to form soap, thereby insoluble in water but soluble in ether.

Reagents. — Glycerol-soda solution, 100 cubic centimeters of

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[1] See "method" under Insoluble Acids for suggestions on drying.

[2] The factor .01 converts the iodine number to the same basis as the figures for theoretical absorption stated on previous page.

sodium hydrate solution (equal parts of soda and water filtered) free from carbonate, to 900 cubic centimeters of pure glycerol.

Ethyl ether, anhydrous and free from alcohol.

Method.[1] — Into a 300 cubic centimeter Erlenmeyer flask are brought 10 grams of fat together with 40 cubic centimeters of glycerol-soda solution, and heated over a naked flame, rotating continuously, until the saponification is complete, as shown by the mixture becoming perfectly clear. The soap is dissolved in slightly warm water, filtered through a dense fat-free filter paper and washed thoroughly. The filter paper and contents are dried and extracted with ethyl ether in a continuous extractor. The extract is dried for two hours in an air bath at 100° C., and considered unsaponifiable matter. The use of a separatory funnel might facilitate matters and would probably yield slightly higher results, as soap is somewhat soluble in ether.

Limit of error, .05 per cent.

Synopsis of Reaction. — Saponification with glycerol-soda. Removal of the soap and other soluble materials with water. Solution of unsaponifiable matter with ether.

Supplementary Notes. — Unsaponifiable matter includes hydrocarbons, mineral oils (petroleum and shale oils), tar oils (neutral coal oils), paraffin, ceresin, rosin oils, the solid fat alcohols of the ethane series (cetyl, octodecyl, ceryl and myricyl) and of the aromatic series (cholesterol, isocholesterol, phytosterol and sistosterol), and possibly some coloring matter. The natural base of wax, monatomic alcohols of ethane series, unlike glycerol, is insoluble in water. Cholesterol is the characteristic solid alcohol of animal fats and oils and phytosterol of the vegetable.

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[1] Not applicable for volatile hydrocarbons.

THE ACIDITY, SULFITE CONTENT AND COLOR OF GLUTEN FEED.

BY P. V. GOLDSMITH, B.SC.

1. Process of Manufacture.

Gluten feed is the name applied to the finely ground endosperm (body of the corn) after the removal of the starch and corn germ. The corn is first soaked in quite dilute sulphurous acid, which softens the grain sufficiently to allow the separation of the various parts; the dilute acid also serves to check excessive fermentation. After soaking for the requisite length of time the corn is coarsely ground and passed through a series of separators, shakers and presses, which process results in a reasonably distinct separation of germ, starch, gluten and hulls. The gluten, together with that portion of the starch which cannot be separated by mechanical means, and the hulls are mixed with the evaporated steep water from the steeping vats, and the mixture dried and ground is the gluten feed of commerce. This so-called steep water, in which the corn was at first soaked, contains much of the more readily soluble material of the corn, and when mixed with the feed after evaporation imparts to it a dark color.

Most of the feeds offered for sale at the present time possess a sharp acid taste and a bright yellow color. The claim has been made that they contain an excess of injurious dyes as well as excessive amounts of sulphurous acid. The object of this investigation has been to determine: —

The nature of the acidity.

The amount of sulphurous acid present.

The presence and source of the added color.

2. Acidity.

The acidity of gluten feeds is manifest to the taste as well as in titration with standard alkali. The following table gives the acidity of a number of feeds collected on the Massachusetts market in 1908.

In determining total acidity, 5 grams of the feed were transferred to a bottle of approximately 500 cubic centimeters capacity, together with 100 cubic centimeters of distilled water. The bottle was then placed in the shaker for fifteen minutes, after which the solution was filtered and an aliquot titrated against N/10 NaOH, using phenolphthalein as an indicator.

(*a*) *Total Acidity (calculated as H_2SO_4).*

[Blank .08 cubic centimeter.]

Laboratory Number.	Color.	Taste.	Acidity (Per Cent.).
370,	Medium,	Slight acid,	.62
371,	Medium,	No acid,	.15
391,	Medium,	Distinct acid,	.72
392,	Medium,	No acid,	.31
393,	Medium dark,	Sharp acid,	.91
394,	Dark,	Sharp acid,	.96
395,	Medium light,	No acid,	.06
459,	Dark,	Acid,	.55
460,	Medium,	Sharp acid,	.86
461,	Light,	Slight acid,	.73
462,	Dark,	Sharp acid,	1.21
463,	Medium,	Slight acid,	.74
506,	Very light,	No acid,	.06
513,	Dark,	Slight acid,	.66
514,	Light,	No acid,	.20
539,	Light,	No acid,	.17
568,	Dark,	Sharp acid,	.86
602,	Medium,	Slight acid,	.57
603,	Medium,	Slight acid,	.70
604,	Medium,	Slight acid,	.63
637,	Light,	No acid,	.38
657,	Dark,	Acid,	.59
687,	Medium,	Sharp acid,	.90
697,	Medium,	No acid,	.31
770,	Dark,	Sharp acid,	.95
795,	Medium,	Slight acid,	.63
796,	Medium,	Sharp acid,	1.02

Color and taste were observed previous to determining acidity.

From the table one notes a range in total acidity of the feeds tested varying from .06 to 1.21 per cent. The high percentages were found only in a few instances, the majority giving a range of .30 to .80 per cent.

By noting color and taste in connection with the determination of total acidity it was found that those feeds possessing a dark or deep yellow color gave, in the majority of cases, a sharp acid taste, and also a relatively high percentage of acid. The relation which exists between depth of color and per cent. of total acidity may be explained as follows: in the process of manufacture there is, as heretofore stated, a certain amount of steep water added to the gluten previous to drying. This steep water carries a relatively high per cent. of acid, which must be neutralized by the addition of soda or lime. It is the bleaching action of the alkali which affects the depth of color; if an insufficient amount of alkali were added to neutralize the acid present there would be a relatively high acidity of the feed, together with a comparatively deeper color, and *vice versa*. It should be noted in connection with the above that while the addition of the steep water to the gluten gives it naturally a darker color, yet this should not be confused with the deep yellow color above referred to, due to the artificial coloration.

(*b*) *Determination of Chlorides.*

Chlorides and sulfates were determined quantitatively in the watery extract of many different samples.

Method for Chlorides. — To 5 grams of the sample were added 100 cubic centimeters of distilled water, as in the determination of total acidity. After shaking, the solution was filtered and 20 cubic centimeters of the filtrate transferred to a porcelain dish and titrated against N/10 sodium hydrate for total acidity, using phenolphthalein as indicator. A few drops of soda were then added to insure a slight excess, and the solution brought to dryness on a water bath, after which the dish was transferred to a gauze top burner and the contents charred at a low red heat. The finely pulverized contents were next taken up with distilled water, filtered, and the insoluble residue well washed with distilled water. The determination of chlo-

rine was made in the filtrate after the usual method, by titration with standard silver nitrate solution, blank determinations being made in every case. The following table gives the chlorine content of several products, calculated as hydrochloric acid: —

Number of Product.	Total Acidity calculated as Hydrochloric Acid.	Chlorine calculated as Hydrochloric Acid.
A, ...	.04	.036
B, ...	.14	.026
C, ...	.79	.077
462, ...	.90	.090

A, sample of corn gluten prepared by writer, without steep water.
B, sample of gluten feed from factory, without color and steep water.
C, sample of gluten feed from factory, without color plus steep water.
462, sample of gluten feed from collection, with color and steep water.

Samples A and B show an average chlorine content of .03 per cent. calculated as hydrochloric acid, which represents a normal chloride content of a gluten without steep water. By comparing this with sample C it will be noted that the percentage of chlorides is somewhat increased by the addition of the steep water. This is not surprising when the fact is considered that the steep water carries with it a relatively high per cent. of the soluble constituents of the corn, and that it is concentrated before being added to the feed. It is evident, however, that the amount of chlorine calculated as hydrochloric acid, as found in the watery extract, is very small when compared with the percentage of total acidity. In the case of sample 462 it equals .09 per cent., as compared with .90 per cent. of total acidity. Furthermore, this is on the assumption that all the water-soluble chlorides in the feed are in the form of free hydrochloric acid, which is not probable for —

1. Any free hydrochloric acid would be readily neutralized by the addition of soda or lime and appear as a salt.

2. Watery solutions of gluten feed, when evaporated to dryness and again taken up with distilled water, show no loss in acidity.

3. On distillation no free hydrochloric acid could be detected.

4. Free hydrochloric acid or other mineral acids, if present even in quite small amounts, would give an acid reaction with methyl orange. (See Indicators.)

(c) *Determination of Sulfates.*

Sulfates were determined in the watery extracts of several products in the usual way,[1] blank determinations being run in every case.

Number of Sample.	Total Acidity calculated as Sulphuric Acid.	Sulfates calculated as Sulphuric Acid.
A,	.06	.0001
B,	.20	.0005
C,	1.06	.0020
462,	1.21	.1550

For explanation of numbers see Determination of Chlorides.

It is evident from the above results that the addition of the steep water causes an increase in the water-soluble sulfate content of the feed. This is accounted for by the fact that the steep water carries more or less of sulfite which is readily oxidized, appearing as sulfate. It is doubtful if any sulfate exists in the feed as free sulphuric acid from the fact that it would be readily neutralized, and that it would react acid to methyl orange even though it be present in small quantities.

(d) *Phosphoric Acid and Composition of Ash.*

A water extract of a gluten feed was prepared by bringing 50 grams of the sample on a filter and washing with warm distilled water until the filtrate equaled 500 cubic centimeters. This was evaporated to dryness on a water bath and carefully ashed. An analysis of the ash gave the following results: —

	Per Cent.
Silica,	Not determined.
Iron and alumina oxides,	.012
Magnesium oxide,	.400
Calcium oxide,	.080
Potassium oxide,	.540
Sodium oxide,	.070
Sulphuric anhydrid (SO_3),	.120
Chlorine,	.039
Phosphoric acid (P_2O_5),	1.010

[1] Precipitation with barium chloride.

The results of the analysis show the ash of the water solution to contain relatively high per cents. of phosphoric acid, potassium oxide and magnesium oxide. It is difficult to state in just what way these various elements are combined; it is probable that they exist in part, at least, in organic combination. From the relatively high per cents. of potassium oxide, magnesium oxide, phosphoric acid and the presence of calcium oxide, it may be inferred that the phosphorus in corn exists in a similar combination as that in wheat bran, namely, as phytin, — a soluble phospho-organic compound containing potassium, magnesium and calcium.[1] Phytin is soluble in water and insoluble in alcohol and ether. Whether or not this compound, if present, bears any relation to the acidity is yet to be determined. It is probable, however, that in the concentration of the steep water the phytin, if present, would undergo a decomposition, in which case phosphoric acid would undoubtedly be formed. It is doubtful if any *free* phosphoric acid exists in the feed; it would probably be present as a salt.

(*e*) *Volatile Organic Acids.*

To determine whether the acidity was due in part to free volatile organic acids, such as lactic, butyric or acetic, etc., distillations of the watery extract were made *in vacuo* at a maximum temperature of 100° C. under 12 millimeter pressure. In no case was there more than a mere trace of acid detected in the distillate, indicating that the amount of free volatile acids in the feed is small. The residue from the distillation was a resinous material, dark brown in color and had a sharp, biting taste. Distillations *in vacuo,* in presence of dilute sulphuric acid, also gave negative results, indicating that little or none of the acidity of gluten feeds is due to the salts of the volatile acids.

(*f*) *Acidity and Indicators.*

The following table gives the acidity of a number of gluten feeds, using both phenolphthalein and methyl orange as indicators: —

[1] Isolated from wheat bran by Patten and Hart, Bulletin No. 250, New York Experiment Station.

Acidity calculated as Sulphuric Acid.

Number of Feed.	Acidity to Phenolphthalein.	Acidity to Methyl Orange.	Number of Feed.	Acidity to Phenolphthalein.	Acidity to Methyl Orange.
432, ...	.10	–	448, ...	2.24	–
433, ...	.14	–	449, ...	1.11	–
434, ...	.79	–	450, ...	.84	–
435, ...	.06	–	451, ...	.92	–
436, ...	.77	–	452, ...	1.38	–
437, ...	.08	–	453, ...	.50	–
438, ...	1.09	–	454, ...	.03	–
439, ...	.06	–	455, ...	.18	–
440, ...	1.48	–	456, ...	.08	–
441, ...	.06	–	457, ...	1.09	–
442, ...	.70	–	458, ...	1.60	–
443, ...	.92	–	459, ...	.78	–
444, ...	.06	–	460, ...	1.53	–
445, ...	1.06	–	461, ...	.08	–
446, ...	1.06	–	462, ...	2.11	–
447, ...	.87	–			

The several titrations indicate that in every case the water solutions of the feed gave a neutral or alkaline reaction with methyl orange. Methyl orange as an indicator possesses rather strong acid properties, *i.e.,* it forms compounds that are quite stable and which require strong acids to decompose them, hence it is much more sensitive to free inorganic acids than to those of an organic nature, some of the latter being entirely unable to replace the acid radical of the indicator.

3. Sulfites.

In the process of manufacture of gluten feed there is, as has been heretofore stated, a certain amount of sulphurous acid added to facilitate the separation of the various parts of the corn. Since sulfites are of a poisonous character it was important to determine whether they were present in the finished feed in sufficiently large amounts to cause any serious results when fed to animals. Sulfites were determined after the usual method, by distilling a considerable amount (50 grams) with

dilute phosphoric acid into bromine water. The excess of bromine was then boiled off and the sulphuric acid formed determined by precipitation with barium chloride. The distillation was conducted in the presence of carbon dioxide, which served to prevent oxidization. Dilute copper sulfate solution[1] was used to purify the sulphur dioxide. Since it was necessary to employ relatively large amounts of the sample for distillation, it was found convenient to place the distilling flask on an oil bath to prevent burning. The following table gives the result of several determinations: —

Number of Sample.	Sulphur Dioxide (Per Cent.).
1,	.0050
2,	.0008
3,	.0040
4,	.0006
5,	none

Blank .0005 in each case.

The results of these various analyses show that the amount of sulphurous acid in the samples of gluten feeds tested was small, and it can be assumed that practically all of the sulphurous acid originally added has been driven off or oxidized to sulphuric acid. Formerly the United States government allowed the addition of sulphur dioxide to foods at the rate of 350 milligrams per kilogram, or .035 of a gram per 100.[2] This decision was later amended,[3] pending determination by the referee board, and at present calls for the labeling of all foods containing even small amounts of sulphur dioxide.

4. Coloring Matter.

In the work presented on coloring matters no attempt has been made to determine the individual dye or combination of dyes used, but rather to ascertain whether the added color was one of vegetable or coal tar origin. The method for the detection of artificial coloring matter in gluten feeds recommended by Gudeman[4] is not applicable in those cases where the sub-

[1] Winton and Bailey, Journal American Chemical Society, Vol. XXIX., No. 10, 1499.
[2] Food inspection decision No. 76, July 13, 1907.
[3] Food inspection decision No. 89, Feb. 28, 1908.
[4] Journal American Chemical Society, Vol. XXX., No. 10 (1908), 1623.

stance on heating becomes solid or semisolid, due to the formation of a starch paste, hence a slight modification was employed.

Method. — To 25 to 50 grams of the sample add 150 cubic centimeters of absolute alcohol[1] and 5 cubic centimeters 1 to 1 ammonia; digest with reflux condenser for three-fourths to one hour, filter, acidify with 10 per cent. hydrochloric acid, add about a square inch of woolen cloth and boil from three-fourths to one hour, to effect a good transfer of color. The wool sample is next washed thoroughly in water, boiled for several minutes in very dilute solution of hydrochloric acid and then again in water, to remove the acid. The color in the wool sample is next dissolved by boiling it in a 1–50 ammonia solution, after which the sample is removed and the bath again made acid, when the second wool sample is added and the boiling of the second acid bath prolonged from one-half to one hour. "The dyeing of the second wool sample, ranging from a bright canary yellow to a deep reddish yellow, is positive proof of added coal tar color."[2] Of 30 samples of gluten feed collected on the Massachusetts market in 1908, 26, or over 80 per cent., were found to contain added aniline color. This coloring is lawful provided the fact is so stated on the food label, as is now the case with most of the gluten products placed on sale.

5. Conclusions.

1. Water solutions of gluten feed react acid to phenolphthalein (.1 to 2.11 per cent. calculated as sulphuric acid) and alkaline or neutral to methyl orange, which would indicate the absence of any appreciable amount of free mineral acid (sulphuric and hydrochloric). The direct determination of the sulfates and chlorides shows them to be present only in small amounts.

2. An analysis of the ash of the water solution shows it to contain considerable potassium, magnesium and phosphoric acid, together with lesser amounts of calcium and sodium. The presence of the several alkalies offers additional evidence of the absence of free mineral acids.

3. The presence of such considerable amounts of potassium, magnesium and phosphoric acid in the extract leads one to sur-

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[1] Jenkins of Connecticut State Station recommends the use of alcohol in first acid bath.

[2] Gudeman in Journal American Chemical Society, Vol. XXX., No. 10 (1908), 1623.

mise that the phosphorus exists in the corn as phytin or a similar organic compound, and that the latter may have been decomposed in the process of evaporating the steep water.

4. Pending further investigation, the acidity of gluten feeds is believed to be due primarily to some form of phosphorus, to a much less degree to the acid salt of sulphuric acid, as well as to traces of sulfites and organic acids. It is advised that the acidity be sufficiently neutralized so that no more than .5 per cent. is shown (calculated as sulphuric acid) when titrated against normal alkali with phenolphthalein as indicator.

5. The gluten feeds examined showed traces only of sulfites, and hence it is concluded they are not present in sufficient amount to be regarded as in any degree injurious to animals.

6. About 80 per cent. of the gluten feeds collected in Massachusetts during 1908 were found to contain aniline (coal tar) dye. It is not believed that the amount present was sufficient to be considered injurious. It is thought, however, that it would be decidedly preferable to omit the color.

In conclusion, the writer wishes to express his thanks to Dr. J. B. Lindsey, Dr. R. D. MacLaurin and Mr. E. B. Holland for their criticisms of the above-described work.

ANIMAL RESIDUES AS A FOOD FOR FARM STOCK.

BY J. B. LINDSEY.

1. Meat and Fish Meals.

As a result of the preparation of beef extract according to the formula of J. von Liebig, which was first undertaken in Uruguay in 1863, there was placed upon the German market a large amount of dried extracted material, — *Fleischfuttermehl,* — which was soon recognized as a superior protein food for all kinds of farm stock. C. Voit,[1] as a result of investigations reported in 1869, showed that, contrary to the generally held opinion, this extracted beef was quite fully digested. The first feeding experiments were carried out to demonstrate its value for farm animals in Uruguay in 1872, after plans submitted by Liebig.[2] Since 1872 numerous brands of beef and fish meals have been offered for sale in Europe, and a great variety of experiments with horses, cattle, sheep, and swine have been made, a most excellent summary of which may be found by consulting Shenke's valuable publication.[2]

The consensus of opinion — based upon the above-mentioned experiments — has been that such material when properly prepared is highly digested, and furnishes an excellent source of protein for dairy stock, horses, sheep, swine and poultry. An exception is made to residues made from decayed or badly diseased animals (*Kadavermehl*). European meat meals of the best grade have been shown to contain an average of 72 to 73 per cent. protein, 13 to 14 per cent. fat, 3.5 to 4.5 per cent. ash (263 analyses), and to be 90 or more per cent. digestible.

[1] Ueber Untersuchungen der animal. und vegetab. Nahrung. München, Sitzungsber. d. math.-phys. Klasse, 1869.

[2] Landw. Versuchsstationen 59 Bd., 1903; also Die Futtermittel des Handels von V. Shenke, p. 737, pub. by P. Paray, Berlin.

European fish meal is guaranteed to contain 59 per cent. protein, 2 per cent. fat, and has been found to be fully 90 per cent. digestible.

Kellner recommends 3 to 4 ounces daily for young pigs and calves, which amount may be increased to 16 ounces, depending upon the size of the animal and the richness of the other foods in nitrogenous matter. Milch cows may be fed as high as 2 pounds daily without any objectionable taste being noted in the milk or butter. Sheep and horses do not take the meal readily, but its consumption can be brought about by mixing it with other grains; about one-half pound daily is recommended.[1]

In the United States up to the present time the various residues from slaughterhouses and fish factories have been utilized chiefly as sources of plant food. Of late the large packers have endeavored to popularize such material in place of or as a supplement to protein concentrates of vegetable origin. Large amounts of meat scraps and meals are consumed in the rapidly increasing poultry industry, and several brands of specially prepared or digester tankage and dried blood are recommended and offered for sale although not generally distributed in local markets.

Tankage for animal feeding is prepared "from scraps of meat of cattle and hogs (lungs, tendons, bones, etc.), cooked for four hours in large steel tanks under 25 to 40 pounds' pressure. . . . The tankage is then pressed, to remove the excess of water and fat, after which the feed is dried and ground." The highest grade contains about 50 to 60 per cent. protein, 10 to 15 per cent. fat and 6 to 10 per cent. bone ash, and has a noticeable odor. It is recommended chiefly as a supplement to corn for feeding pigs, in the proportion by weight of 1 part tankage to 5 to 10 parts corn. While a proportion of 1 to 5 has given slightly better results, the opinion is expressed by several experimenters that so large a proportion of tankage is not as profitable as the smaller amount.[2] It seems probable that 1 part tankage to 5 parts corn could be given advantageously to young pigs, and

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[1] Kellner, Die Ernahrung d. landw. Nützthiere, pp. 369-371.

[2] Iowa Experiment Station Bulletin No. 65; Purdue Experiment Station Bulletin Nos. 90 and 108; Michigan Experiment Station Bulletin No. 237; Nebraska Experiment Station Bulletin No. 94; South Dakota Experiment Station Bulletin No. 90; Virginia Experiment Station Bulletin No. 167.

the proportion of corn increased as the process of fattening progressed.

The Massachusetts station fed Swift's digester tankage to two dairy cows in place of twice the amount of high-grade distillers' grains (33 per cent. protein). One-half pound of tankage daily was first fed and the amount gradually increased to 1½ pounds per day; the total grain ration consisting of 4 pounds wheat middlings, 1 pound distillers' grains and 1½ pounds tankage, or 5 pounds molasses beet pulp, 2 pounds middlings and 1½ pounds tankage. Neither of the animals made any objections to the tankage when mixed with the other grains, in spite of its noticeable odor. Frequent samples of milk were examined, both cold and at a lukewarm temperature, but it was not possible to detect any flavor or odor that could be attributed to the meat product. It is hardly considered advisable, however, to feed such material to dairy stock.

2. Dried Blood for Stock.

Dried blood for feeding purposes is prepared by heating the fresh blood of cattle and swine in large tanks at 212° F. The excess of water is removed from the coagulated mass by means of heavy presses and the material then passed through steam dryers and eventually ground and bagged. As thus treated it appears as a dry, friable powder of dark color and with only a slight odor.

One finds comparatively few experiments described and little said in agricultural publications relative to the value of blood meal for animal nutrition. Kellner[1] states that "when it is prepared without being overheated, it has proved itself to be a very easily digested protein food stuff, suitable for all farm animals, readily consumed and to be fed in the same amounts as meat meal. It is found to be quite satisfactory as a constituent of fodder bread and biscuit and of the less valuable molasses feeds."

In the United States several stations[2] report feeding trials with blood combined with carbonaceous foods (corn), in which

[1] Already cited.

[2] Missouri Agricultural College Bulletin Nos. 14, 19; Wisconsin Experiment Station Reports, 1886, 1887, 1888, 1889.

it is shown that the addition of the blood produced a more rapid and healthy development of the body and tended to increase the proportion of lean meat.

The Kansas station[1] has found a teaspoonful of soluble blood flour added to each feeding of milk to be quite efficacious in checking mild cases of scours in calves.

Observations at the Massachusetts Station with Blood Meal.

The station procured a quantity of Armour's blood meal and made the following observations: (1) composition; (2) digestibility; (3) its value as a source of protein in place of cottonseed meal.

(1) *Composition (Per Cent.).*

	Armour's Blood Meal.	Foreign Samples for Comparison.		
		Blood Meal.	Meat Meal (High Grade).	Fish Meal.
Water,	11.12	9.00	10.80	12.80
Ash,	3.18	4.20	3.80	32.60
Protein,	84.64	83.90	72.30	52.50
Fiber,	.69	-	-	-
Extract matter,	-	-	-	-
Fat,	.37	2.50	13.10	2.10
Totals,	100.00	99.60	100.00	100.00

The small percentage of fiber in the American brand was due evidently to scattered splinters or to sacking. It resembles closely the foreign article, except that the latter contains more fat. Blood meal is the highest grade protein concentrate suitable for animal feeding.

(2) *Digestibility.*

The detailed data of this experiment have been already published.[2] The blood was fed to two sheep in combination with hay and corn meal. The sheep digested 95.14 per cent. of the dry matter of the blood. The protein appeared to have been less thoroughly digested, namely, 84 per cent. It is probable that the protein digestibility was somewhat depressed by the meta-

[1] Bulletin No. 126, p. 184.

[2] Seventeenth report of the Hatch Experiment Station, pp. 45-77.

bolic by-products. Judging from the digestibility of the total dry matter of the blood it may be safely concluded that the blood protein must be quite thoroughly utilized by farm animals. Kellner[1] found the protein in blood meal to be 92 per cent. digested; Wildt[2] secured protein coefficients of from 61 to 72 per cent. on samples of blood which had been overheated.

(3) *Blood Meal v. Cotton-seed Meal for Dairy Cows.*

Object of the Experiment. — To compare the total protein of dried blood with an equal amount of protein in cotton-seed meal upon the yield of milk and milk ingredients, and to note its economy and suitability as a protein concentrate for dairy stock.

Plan of the Experiment. — Four cows, Blanche, Brighty, Dora and May, were divided into two lots and fed by the usual reversal method. The care and weighing of the animals, method of feeding and sampling of milk were the same as in the alfalfa meal experiment (pages 158–166).

Data concerning Cows.

Name.	Breed.	Last Calf dropped.	Served.	Milk Yield at Beginning of Experiment (Pounds).
		1903.	1903.	
Blanche,	Grade Jersey,	Aug.,	Dec. 31,	26–27
Brighty,	Grade Jersey,	Aug.,	Dec. 24,	24–25
Dora,	Grade Jersey,	Aug.,	Nov. 23,	24–25
May,	Grade Jersey,	Aug.,	–	27–28

Duration of Experiment, 1903.

Dates.	Blood Meal Ration.	Cotton-seed Meal Ration.
October 17 through November 13,	Blanche and Brighty,	Dora and May.
November 21 through December 18,	Dora and May,	Blanche and Brighty.

It will be seen that the experiment proper lasted four weeks, with an interval of seven days between the two halves.

[1] Already cited.

[2] Landw. Jahrbücher 6 Bd., 1877, p. 177.

Total Rations consumed by Each Cow (Pounds).

Blood Meal Ration.

Cows.	First-cut Hay.	Bran.	Hominy Meal.	Blood Meal.	Cotton-seed Meal.
Blanche,	616	84	112	35	–
Brighty,	504	84	112	28	–
Dora,	504	84	112	28	–
May,	616	84	112	35	–
Totals,	2,240	336	448	126	–

Cotton-seed Meal Ration.

Cows.	First-cut Hay.	Bran.	Hominy Meal.	Blood Meal.	Cotton-seed Meal.
Blanche,	616	84	84	–	70
Brighty,	504	84	84	–	56
Dora,	504	84	84	–	56
May,	616	84	84	–	70
Totals,	2,240	336	336	–	252

Average Daily Ration consumed by Each Cow (Pounds).

Character of Ration.	First-cut Hay.	Wheat Bran.	Hominy Meal.	Blood Meal.	Cotton-seed Meal.
Blood meal,	20	3	4	1.13	–
Cotton-seed meal,	20	3	3	–	2.25

The first-cut hay consisted largely of Kentucky blue grass together with some clover. The bran and hominy were of good average quality. The blood obtained of Armour & Co. was especially prepared for cattle feeding, and tested 84.64 per cent. protein; the cotton-seed meal was bright in color and tested 45.36 per cent. protein. It will be seen that twice as much cotton-seed meal as blood was fed, the corresponding amounts furnishing approximately like amounts of digestible protein. The deficiency of carbohydrate material in the blood was made up by the addition of an extra pound of hominy meal. The average basal ration consisted of 20 pounds hay, 3 pounds bran and 3 pounds hominy, while the addition was 1 pound hominy and 1.13 pounds blood, against 2.25 pounds cotton-seed meal.

Average Dry and Digestible Nutrients in Daily Rations (Pounds).

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.	
Blood meal,	25.14	2.46	3.79	8.45	.61	15.31	1:5.5
Cotton-seed meal,	25.27	2.49	3.84	8.19	.72	15.24	1:5.5

The above figures were obtained by the use of average digestion coefficients applied to actual analyses of the several feed stuffs. The calculations indicate that both rations furnished practically the same amount of digestible nutrients, and that the ratio between the carbo-hydrates and the protein was the same. If any difference was to result from the feeding effect of the two rations, one would expect it to be favorable to the blood ration, for the reason that blood and hominy would require somewhat less energy for their digestion than would a like amount of cotton-seed meal.

Herd Gain in Live Weight.

Character of Ration.	Pounds.
Blood meal,	+122
Cotton-seed meal,	—8

The blood meal ration favored a noticeable increase in live weight.

Total and Daily Yields (Pounds).

Blood Meal Ration.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent.
Blanche,	737.26	26.33	103.36	36.42	42.49
Brighty,	668.66	23.88	97.02	37.65	43.93
Dora,	678.05	24.22	90.45	30.85	35.99
May,	695.99	24.85	101.06	35.77	41.73
Totals,	2,779.96	–	391.89	140.69	164.14

Total and Daily Yields (Pounds) — Concluded.

Cotton-seed Meal Ration.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent.
Blanche,	712.40	25.44	102.23	36.40	42.47
Brighty,	601.27	21.47	91.15	36.44	42.51
Dora,	685.92	24.50	90.40	31.07	36.25
May,	755.02	26.97	109.02	38.66	45.10
Totals,	2,754.61	-	392.80	142.57	166.33

The results secured show that the yields of milk, total solids and fat were practically identical in each period.

Food Cost of Milk and Butter.

Character of Ration.	Total Food Cost of Milk.	Cost of One Hundred Pounds of Milk.	Cost of One Pound of Butter.
Blood meal,	$29 00	$1 04	$0 177
Cotton-seed meal,	28 18	1 02	169
Percentage increased cost when blood meal was fed,	-	2.00	5.00

The milk and butter produced by the blood meal ration cost slightly more than that produced by the cotton-seed meal ration. This was due to the fact that 1.13 pounds of blood and 1 pound of hominy cost 4.2 cents, as against 3.26 cents, the cost of 2.25 pounds of cotton-seed meal.

Dry and Digestible Matter required to produce Milk and Butter (Pounds).

Character of Ration.	Dry Matter.			Digestible Nutrients.		
	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.
Blood meal,	101.26	7.18	20.01	61.64	4.37	12.18
Cotton-seed meal,	102.75	7.21	19.85	61.96	4.35	11.97

Hay was figured at $15; bran, $22; hominy, $24; cotton-seed meal, $29; and blood, $55 a ton.

Practically the same amounts of dry and digestible matter were required to produce equal amounts of milk, milk solids and milk fat.

Effect of Blood Ration on Milk Flavor and on Animals.

Frequent samples of milk were taken in sterilized milk bottles, carried to the laboratory and tasted, both cold and lukewarm. It was not possible to detect any objectionable flavor which could be attributed to the blood. The blood ration in no way interfered with the normal condition of the animals, all of which consumed it readily.

The only disturbance noted in the experiment was that of the cow Brighty while being fed the cotton-seed meal ration. She was attacked with indigestion on November 29 and was out of the experiment until December 12, when she again returned to her normal condition and milk flow. She was continued from December 12 until January 1, thus completing her four weeks' record, although the experiment for the remainder of the herd ceased December 18.

3. Conclusions.

1. Dried blood contains some 85 per cent. of protein, and when properly prepared (not overheated) has proved itself to be highly digestible and well suited as a concentrated protein nutrient for farm stock.

2. For cows in milk it may be fed in amounts varying from 1 to 2 pounds daily, mixed with concentrates of vegetable origin. A satisfactory combination for a day's ration consists of 2 to 3 pounds of wheat bran, 2 to 3 pounds of corn or hominy meal and 1.5 pounds of dried blood. Other mixtures can be made containing blood as a constituent.

3. It is believed to be the part of economy to first utilize blood as an animal food rather than to apply it directly as a fertilizer.

4. The present price of prepared blood, its lack of distribution in local markets and the ignorance of the consumer concerning its merits as a food have thus far prevented its general use for feeding purposes.

ALFALFA MEAL v. WHEAT BRAN FOR MILK PRODUCTION.

October to December, 1906.

BY J. B. LINDSEY.

The merits of alfalfa hay, when early cut and well cured, are fully recognized by feeders of farm stock. Considerable alfalfa hay is ground and offered as a food for poultry and as a substitute for wheat bran. The station has made a comparative study of the merits of ground alfalfa and bran for milk production, and briefly presents the results secured.

Composition of Alfalfa (Per Cent.).

	Alfalfa Meal used in Experiment.	Alfalfa Hay for Comparison.	Wheat Bran used in Experiment.	Average for Wheat Bran.
Water,	10.06	9.56	11.61	10.00
Protein,	13.01	13.24	15.60	16.30
Fat,	1.28	3.36	4.28	4.40
Fiber,	32.32	31.07	9.40	10.00
Extract matter,	35.39	34.13	52.98	53.10
Ash,	7.94	8.64	6.13	6.20
Totals,	100.00	100.00	100.00	100.00

The alfalfa meal was put out by the Ralston Purina Company, which stated that it was made from a good quality of alfalfa hay. Alfalfa hay, the composition of which is given in the second column for comparison, was grown at the New Jersey experiment station and was pronounced a representative sample.

Alfalfa differs chemically from bran in containing rather less protein, decidedly less extract matter and correspondingly more fiber. Both have a high ash percentage, which renders them well suited as foods for young stock.

Digestibility of Alfalfa.

This station has not conducted digestion experiments with alfalfa as so many excellent investigations have been made elsewhere, especially in Kansas and Utah. The resulting average coefficients follow: —

	Number Different Lots.	Number Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Alfalfa, . .	21	39	62	53	72	47	72	43
Wheat bran, .	4	10	66	–	77	39	71	63

Organic Matter digestible in 2,000 Pounds.

	Protein.	Fiber.	Extract Matter.	Fat.	Total.
Alfalfa, ...	190.6	292.0	491.4	28.9	1,002.9
Wheat bran, ...	251.0	78.0	754.0	55.4	1,138.4

It will be seen that bran furnishes noticeably more digestible protein, extract matter and fat than alfalfa; the latter has a much larger percentage of digestible fiber. Fiber requires more energy for its digestion than the other groups of nutrients. Bran contains over 100 pounds more total digestible organic nutrients to the ton, and, other things being equal, should be regarded, ton for ton, as a more economical food for milk production.

Feeding Experiment with Cows.

Alfalfa Meal v. Wheat Bran.

Object of the Experiment. — To compare the effect of alfalfa meal with wheat bran (*a*) upon the general health and condition of the animal, (*b*) upon the yield of milk, milk solids and milk fat, and (*c*) to note the economy of alfalfa as compared with bran as a food for dairy stock.

Plan. — Six cows, all of which were new milch in the late summer, were divided as evenly as possible into two lots of three each. In the first half of the trial three of the cows received the alfalfa meal ration for six consecutive weeks (one

week preliminary) at the same time the other three received the wheat bran ration. In the second half of the trial the conditions were reversed.

Data concerning Cows.

NAMES.	Breed.	Age (Years).	Last Calf dropped.	Milk Yield at Beginning of Experiment (Pounds).
			1906.	
Blanche,	Jersey, grade,	11	Sept.,	24
Daisy,	Jersey, grade,	9	Aug.,	20
May,	Jersey, grade,	11	Aug.,	23
Samantha,	Jersey-Holstein,	4	Sept.,	28
Fancy,	Jersey, grade,	6	Aug.,	19
May Rio,	Jersey, pure,	4	Aug.,	21

Duration of the Experiment.

DATES.	Alfalfa Meal Ration.	Wheat Bran Ration.
October 13 through November 16,	Samantha, Fancy, May Rio.	Blanche, Daisy, May.
November 24 through December 28,	Blanche, Daisy, May,	Samantha, Fancy, May Rio.

General Care and Feeding. — The experiment was conducted in the station barn especially set apart for such work. Each animal was kept in a roomy stall, well carded and turned daily into a yard for exercise. The daily feed was given in two portions, and water was kept continuously before each animal. All of the cows were in good condition at the beginning of the trial.

Weighing. — Each animal was weighed for three consecutive days at the beginning and end of each half of the trial. The weight was taken in the afternoon, as the cows were brought in from the yard, previous to feeding and watering.

Sampling Feeds. — The coarse fodders were sampled at the beginning, middle and end of each half of the trial, dry matter determinations made at once, and the several samples composited. The grains, including the alfalfa meal, were sampled daily into glass-stoppered bottles, and the composites tested for

dry matter at the end of each half of the trial, and eventually completely analyzed. Sufficient of each of the several grains was purchased at one time to last during the entire experiment.

Sampling Milk. — The milk of each cow was sampled twice daily for five consecutive days and preserved in glass-stoppered bottles. The method of sampling consisted in mixing the freshly drawn milk with an especially constructed mixer, and immediately removing a small dipperful.

Character of the Feeds. — The hay and rowen were of excellent quality. The former was a mixture of Kentucky blue grass with some clover and the latter was largely grass rowen. The quality of the bran was not particularly satisfactory. It was bought by sample, and had the appearance of being a fairly clean, winter wheat product. As the experiment progressed it was found that some bags contained a considerable admixture of middlings and some wheat hulls. Towards the latter part of the second half of the trial the variation became so noticeable that Washburn Crosby's spring bran was substituted for the remainder of the experiment. The source and quality of the alfalfa meal have already been mentioned.

Effect of Alfalfa on General Condition.

The alfalfa meal was fed mixed with the other grains. The animals ate the mixture readily and kept in uniformly good health, as did those receiving the bran ration. The alfalfa ration produced rather more of a laxative effect than did the bran.

Total Feeds consumed (Pounds).

Alfalfa Meal Ration.

Cows.	First-cut Hay.	Rowen.	Alfalfa Meal.	Wheat Bran.	Gluten Feed.	Corn Meal.
Blanche, . .	455	280	175	-	35.0	105.0
Daisy, . . .	420	210	175	-	52.5	52.5
May, . . .	385	280	175	-	52.5	52.5
Samantha, . .	455	280	175	-	35.0	105.0
Fancy, . . .	385	210	175	-	52.5	52.5
May Rio, . .	350	210	140	-	52.5	52.5
Totals, . .	2,450	1,470	1,015	-	280.0	420.0

Total Feeds consumed (Pounds) — Concluded.

Wheat Bran Ration.

Cows.	First-cut Hay.	Rowen.	Alfalfa Meal.	Wheat Bran.	Gluten Feed.	Corn Meal.
Blanche,	455	280	-	175	35.0	105.0
Daisy,	420	210	-	175	52.5	52.5
May,	385	280	-	175	52.5	52.5
Samantha,	455	280	-	175	35.0	105.0
Fancy,	385	210	-	175	52.5	52.5
May Rio,	350	210	-	140	52.5	52.5
Totals,	2,450	1,470	-	1,015	280.0	420.0

Average Daily Ration consumed by Each Cow (Pounds).

Character of Ration.	First-cut Hay.	Rowen.	Alfalfa Meal.	Wheat Bran.	Gluten Feed.	Corn Meal.
Alfalfa meal,	11.7	7.0	4.8	-	1.3	2.0
Wheat bran,	11.7	7.0	-	4.8	1.3	2.0

It will be seen that the basal ration consisted of hay, rowen, gluten feed and corn meal, to which were added an average of 4.8 pounds of alfalfa meal or wheat bran, so that a definite amount of the alfalfa was compared with a like amount of the bran.

Dry Matter and Digestible Nutrients in the Daily Rations (Pounds).[1]

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.	
Alfalfa,	23.87	1.88	4.20	8.08	.35	14.51	1:6.9
Wheat bran,	23.79	2.01	3.64	8.66	.44	14.75	1:6.6

The total amount of dry matter in the two rations was practically identical, while the total digestible nutrients consumed show but slight variations. The chief difference consisted in the excess of fiber in the alfalfa meal ration. One would

[1] Calculated from actual analyses and average digestion coefficients.

naturally assume that a little less milk and milk products would be produced by the alfalfa meal ration, because of the increased energy required to digest the excess of fiber.

Herd Gain in Live Weight.

Character of Ration.	Pounds.
Alfalfa meal,	119+
Wheat bran,	165+

Both herds made a substantial gain; the bran ration gave the better results.

Yield of Milk and Milk Ingredients (Pounds).

Wheat Bran Ration.

Cows.	Total Milk.	Daily Milk per Cow.	Total Solids.	Total Fat.	Butter Equivalent (1/6 added).
Blanche,	756.12	21.60	106.23	36.29	42.34
Daisy,	599.56	17.13	91.61	34.41	40.15
May,	798.65	22.82	113.49	40.41	47.15
Samantha,	736.73	21.05	114.49	42.88	50.03
Fancy,	629.00	17.97	89.57	30.82	35.96
May Rio,	546.53	15.61	79.79	30.50	35.58
Totals,	4,066.59	19.36	595.18	215.31	251.21
Alfalfa Ration.					
Blanche,	734.87	21.00	106.63	36.67	42.78
Daisy,	532.90	15.23	85.96	32.99	38.49
May,	717.14	20.49	108.00	37.94	44.26
Samantha,	797.77	22.79	114.88	42.68	49.79
Fancy,	631.74	18.05	97.29	28.62	33.39
May Rio,	588.23	16.81	80.23	30.00	35.00
Totals,	4,002.65	19.06	592.99	208.90	243.71
Percentage gain of bran over alfalfa ration.	1.6	1.6	.4	3.1	3.1

The above statement indicates that the bran ration gave results slightly superior to the alfalfa meal ration, namely, 1.6 per cent. more milk and 3.1 per cent. more butter, but during

the entire period of thirty-five days the cows did not respond readily to either ration. The reason for this was due probably, in part, to the fact that bran or alfalfa (feeds having a comparatively low digestibility) made up nearly 60 per cent. of the grain ration, and partly because of the wide nutritive ratio of the rations. Both rations eventually tended to produce a slow accumulation of body fat rather than to stimulate the flow of milk (note gains in live weight). Incidentally it may be stated that the writer does not consider it economical, as a rule, to use more than 25 to 40 per cent. of bran in rations intended for milk production. The former amount may be employed when the remainder of the ration is composed of rather bulky concentrates, and the latter with heavy concentrates, such as combinations of cotton-seed and corn meals.

Average Composition of the Herd Milk.

Character of Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
Alfalfa meal,	14.81	5.22	9.59
Wheat bran,	14.63	5.29	9.34

The variations in the quality of the milk are not sufficiently pronounced to warrant any particular deductions.

Dry and Digestible Matter required to produce Milk and Milk Ingredients (Pounds).

Character of Ration.	Dry Matter.			Digestible Nutrients.		
	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.
Wheat bran,	122.87	8.40	23.20	76.22	5.21	14.40
Alfalfa,	125.22	8.45	23.99	76.11	5.14	14.58

It apparently required substantially equal amounts of digestible matter to produce equal amounts of milk and milk products.

Food Cost of Milk and Butter.

Character of Ration.	Total Milk.	One Hundred Pounds Milk.	One Quart Milk (Cents).	One Pound Butter (Cents).
Wheat bran,	$49 01	$1 21	2.72	19.5
Alfalfa,	53 07	1 32	2.97	21.8
Percentage decreased cost of bran over alfalfa ration.	9.20	9.20	9.20	9.0

The several feed stuffs were figured at the same price per pound, excepting the wheat bran and alfalfa; the former cost $22 and the latter $30 a ton in the market. On this basis the alfalfa ration would increase the cost of milk and butter some 9 per cent. If the bran and alfalfa were figured at the same price a ton, the food cost of the product would vary very slightly.

Approximate Fertilizer Ingredients in Rations.

Wheat Bran Ration.

104.54 pounds nitrogen, valued at 18½ cents a pound, equals	$19 34
79.36 pounds potash, valued at 4¼ cents a pound, equals	3 37
48.52 pounds phosphoric acid, valued at 4 cents a pound, equals	1 94
	$24 65

Alfalfa Ration.

82.32 pounds nitrogen, valued at 18½ cents a pound, equals	$15 23
68.30 pounds potash, valued at 4¼ cents a pound, equals	2 90
21.02 pounds phosphoric acid, valued at 4 cents a pound, equals	84
	$18 97

Owing to the excess of fertilizer ingredients, especially nitrogen, in the wheat bran, the bran ration would furnish a somewhat richer manure. This fact should not be entirely lost sight of in comparing the merits of the two feeds.

Conclusion.

1. Wheat bran contained nearly 3 per cent. more protein and very much less fiber than did alfalfa meal; bran also has fully 100 pounds more digestible matter to the ton, and noticeably more of the elements of fertility.

2. The present experiment indicates that, pound for pound, wheat bran was slightly superior to alfalfa for the production of milk. Both feeds act as slight laxatives, and are well suited to dilute or distribute the heavy concentrates.

The results secured from a single experiment should not be regarded as conclusive. The composition and digestibility of the alfalfa meal, as well as the feeding experiment described, all point in the same direction, and strongly indicate that the above conclusions are correct. It is believed that if the grain ration had consisted of alfalfa and corn meal, or bran and corn meal, — that is, if gluten feed had been excluded from the ration, — the results would have been more favorable to the bran. The gluten feed supplied a sufficiency of protein, and had it been omitted its loss would have been more noticeable in case of the alfalfa ration.

The writer can see no advantage in replacing bran by alfalfa meal, for the reason that the quality of the latter as measured by the grade of the hay employed is likely to vary considerably. Late-cut alfalfa has a low digestibility, and will prove decidedly inferior to a good quality of bran. Mairs[1] made an experiment to compare bran and alfalfa meal and drew the following conclusions: (1) " The results of this test do not warrant the recommendation of alfalfa meal as a substitute for wheat bran as a feed for dairy cows at the present market prices (bran $20 a ton, alfalfa meal $23)." (2) " The alfalfa meal was less palatable, and resulted in a decreased milk production in every case." (3) "*At the same price per ton,* alfalfa meal produced milk in one case for a cent less and in another case at the same price per hundred pounds."

The writer noted that the quality of the alfalfa meal used by Mairs was superior to the average alfalfa hay.

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[1] Pennsylvania Experiment Station, Bulletin No. 80.

VARIATION IN PEAS.

F. A. WAUGH AND J. K. SHAW.

A preliminary report of these studies in variation of peas was made last year.[1] Since that time the experiments have been continued and many interesting data secured. The work was done largely by Mr. C. S. Pomeroy.

Primarily these experiments were designed to give some accurate knowledge of variation in a common variety of garden

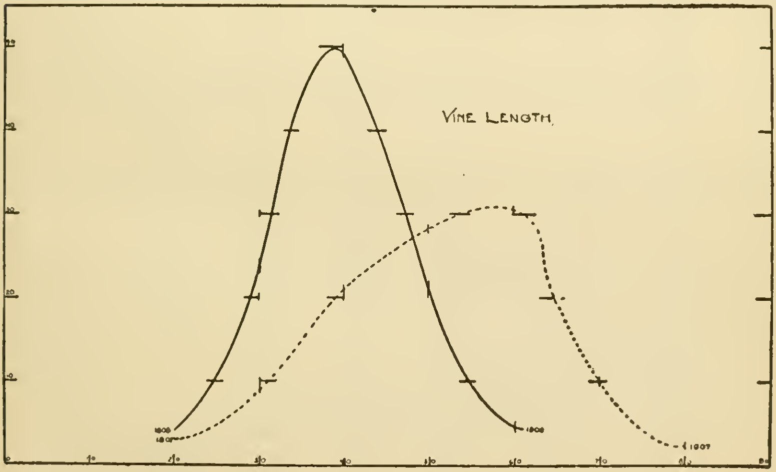

FIG. 1.

peas, Nott's Excelsior. Hitherto our knowledge of such matters has been too meager and inexact to have any scientific value or to supply a proper basis for progress in practical plant breeding. As the work has gone on other problems have come up, including

[1] Massachusetts Agricultural Experiment Station, Report 20; p. 65 (1908).

questions in heredity and in correlation of characters. In this year's work there has been nothing developed in the correlation

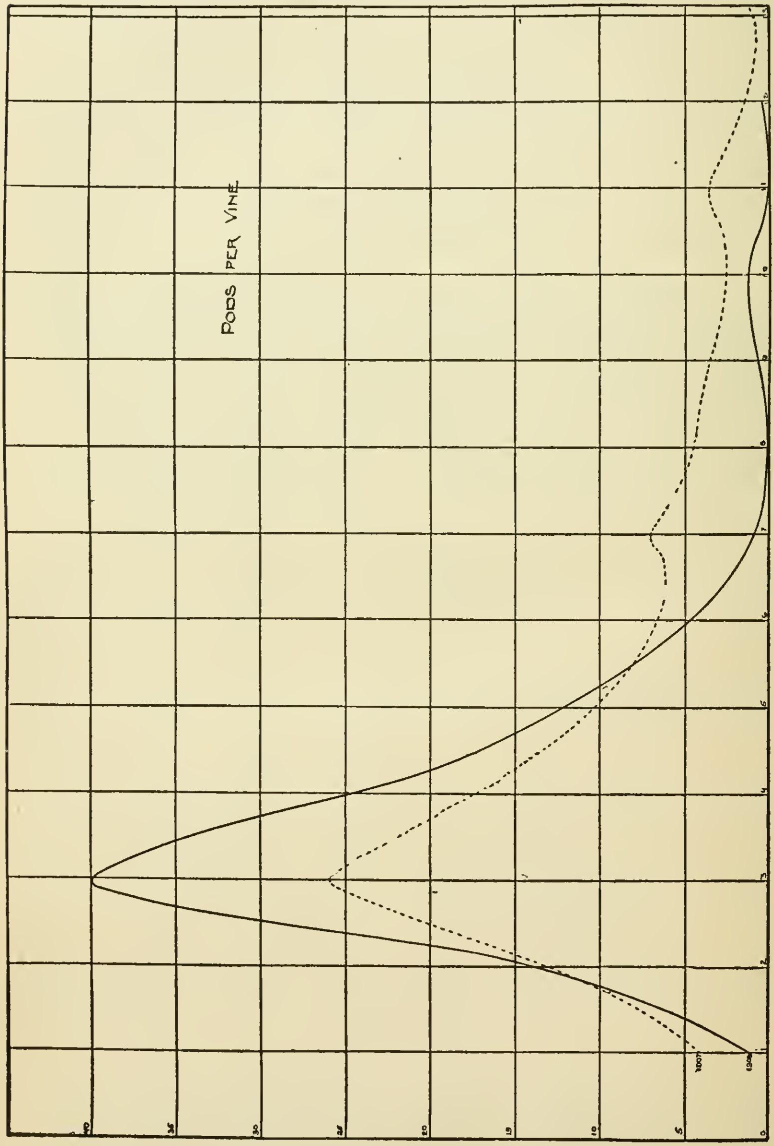

FIG. 2.

studies of sufficient importance to make a report necessary, but some data are given herewith as to the other two subjects, viz., variation and heredity.

Studies in Variation.

In our last report figures and diagrams were given to show the amount and range of variation in several qualities, namely, (1) length of vine, (2) number of pods per vine and (3) number of peas per pod. It will now be of interest to compare the variation of 1908 with that shown in 1907, remembering that the plants of 1908 were the progeny of those grown in 1907.

Before taking up the figures, attention should be called to the fact that the very dry summer of 1908 shows its effects very

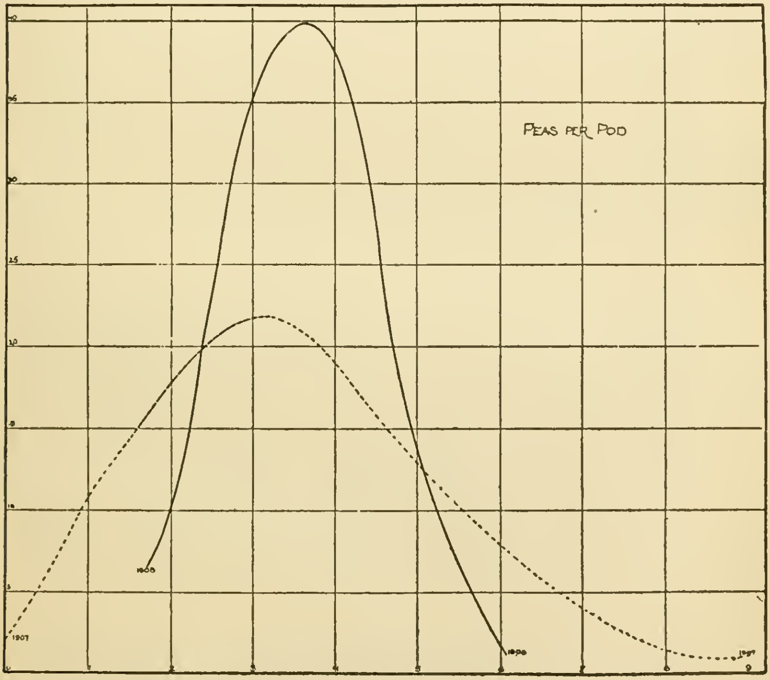

FIG. 3.

plainly in these figures. Inasmuch as the crop was grown on dry, gravelly land these effects of drought were intensified. The length of vines was therefore much shorter, the number of pods generally less and the peas per pod fewer, than in 1907. This need not affect the amount and character of variations, however. When the data are exhibited graphically, as in Figs. 1, 2 and 3, the curves of 1907 and of 1908 ought to show some plain correspondence.

An inspection of the graphs will show that this is the actual result. The curves for 1908 show smaller plants with fewer pods, but there is, nevertheless, a very striking similarity in the scope and character of variation in the two years. (See Figs. 1, 2 and 3.)

The general character of the results may also be seen from the following table: —

Variation in Peas.

	Length of Vine (Centimeters).	Number of Pods per Vine.	Length of Pod (Centimeters).	Number of Peas per Pod.
Minimum, 1907,	20.000	1.000	2.00	-
Minimum, 1908,	19.000	1.000	2.00	-
Maximum, 1907,	88.000	13.000	9.50	9.00
Maximum, 1908,	61.000	12.000	8.00	8.00
Average, 1907,	54.700	4.680	6.88	3.46
Average, 1908,	38.218	3.908	6.10	3.44

179 vines studied in 1907; 225 vines studied in 1908.

Differences in Variability.

A striking feature in this experiment — as in most others of a similar sort — comes out in the marked differences of variability in different groups of progeny. For example, if we consider the total product in peas per vine, we may compute that the progeny of parent C showed more than double the amount of variation found among the progeny of parent B or J. These figures are so interesting that they are given in full in the following table. (Coefficient of variability is equal to standard deviation divided by the mean.)

Coefficients of Variability.

	Vine Length.	Pods per Vine.	Peas per Pod.	Total Peas.
Parent A,	12.1	25.3	6.73	40.6
Parent B,	14.1	10.1	6.41	23.7
Parent C,	11.8	52.1	6.80	49.0
Parent D,	15.8	8.1	8.20	41.7
Parent E,	20.2	9.1	28.30	46.2
Parent G,	14.7	16.7	25.00	31.3
Parent H,	15.1	8.0	6.80	40.2
Parent J,	10.1	6.3	9.98	23.9
Parent K,	8.8	7.4	5.67	27.7

Studies in Heredity.

From the beginning of this experiment careful studies in heredity have been planned. As this year's report covers only the second generation of peas no very conclusive results could be expected. It must be confessed, however, that the figures for this year not only lack conclusiveness but they are decidedly confusing. It was to be expected, of course, that the progeny of prolific vines would be more prolific than those from unprolific vines, and that plants which in 1907 gave a large number of peas per pod would yield progeny in 1908 with relatively large numbers of peas per pod. As a matter of record, this reasonable expectation of heredity was not fulfilled to a degree which would satisfy any practical plant breeder.

The measure of heredity is best computed by the methods introduced by Galton, and improved by Pearson in England, and now used largely among scientific plant breeders in America. This method involves somewhat complicated mathematics, which we need not take up here.[1] It will be sufficient if we explain that absolutely perfect inheritance (which never occurs) would be represented by the integer 1, and that various degrees of heredity would be measured by decimal fractions or percentages running down from 1 to 0. It may be said, further, that careful studies of most subjects where heredity is known to operate normally show coefficients varying from .15 to .52 or .53, but a coefficient as large as .50 seems to be rare. In human beings, for example, heredity seems to run at about .30. Certain computations will even show slightly negative results; but unless the figures are large, such negative coefficients indicate only that heredity has been practically obliterated with respect to the individuals and the characters under examination.

The coefficients of heredity shown in the pea progeny of 1908 were as follows: —

Coefficients of Heredity.

Length of vine,	+.170
Pods per vine,	+.158
Peas per pod,	—.083
Total peas per vine,	+.035

[1] Any one wishing to study this method of measuring heredity may consult E. Davenport's Principles of Breeding, p. 486.

While these are average results, there were, as always, some exceptional cases of individual vines which showed a marked ability to transmit their individual characters to their offspring. The selection of such prepotent plants is evidently an important matter in plant breeding. In order to exhibit this difference we have computed a coefficient of heredity for each parent and for each character under study, as shown in the following table. These computations were made from the following formula: —

$$C = \frac{1}{\sigma D}$$

In this formula

$C =$ Coefficient of heredity.
$\sigma =$ Standard deviation of offspring.
$D =$ Difference between numerical value of the parent character and mean of the same character in the progeny.

Coefficients of Heredity.

	Vine Length.	Pods per Vine.	Peas per Pod.	Total Peas.
Parent A, ...	.0068	.145	8.33	.0066
Parent B, ...	.0085	.011	54.34	.0269
Parent C, ...	.0106	.104	.43	.0063
Parent D, ...	.0086	.512	7.14	.0125
Parent E, ...	.0042	3.003	.41	.0158
Parent G, ...	.0605	.327	.68	.0075
Parent H, ...	.0071	.490	4.00	.0067
Parent J, ...	.0095	5.555	2.08	.0274
Parent K, ...	.0250	14.285	8.70	.0675

In examining this table it must be understood that only the coefficients in the same vertical columns are directly comparable with one another.

It will be seen that with respect to length of vine parents G, K and C were the most prepotent; that with respect to the production of pods parents K, J and E were the most prepotent; that in the matter of peas per pod parents B, K and A were the most prepotent; that as to total peas parents K, J and B take the lead.

One very striking point in this comparison lies in the fact that individual parents vary so much in the transmission of different characters. For example, parent B stands at the head in the transmission of the character "peas per pod" and at the foot for "pods per vine." Similar lack of correspondence is seen in many other cases. These facts, however, surprising though they may seem at first sight, really conform to the more modern theories of heredity, in which it is understood that different characters are often transmitted as independent units.

Nevertheless, some interesting observations on the other side should not be overlooked. Parent K, for example, stands at the head in the transmission of two of the qualities studied, and stands second for the other two. Parent J also stands second in the transmission of two characters. On the other hand, parent C shows the minimum power of transmission in one character and stands next to the foot in two others. Parent E falls to the minimum place in two characters, though ranking fairly high in the other two. From these figures it would appear fair to give K the sweepstakes prize for all-round prepotency.

THE INFLUENCE OF STOCK ON CION IN THE GRAFTAGE OF PLUMS.

BY F. A. WAUGH.

One of the most interesting questions in the whole field of horticulture is that of the mutual influences of stock on cion or of cion on stock in the common practice of graftage. This question has long been the subject of speculation and study in the horticultural world, but really definite results have been so hard to secure that the whole field still presents more of doubt than of certainty. Several years ago the writer, then connected with the Vermont Agricultural Experiment Station, began a series of experiments in cross-grafting plums, designed to throw some light on these problems. These experiments have been continued in one form or another ever since, and are still under way in the department of horticulture, Massachusetts experiment station.

In one particular experiment, begun in 1898, the comparisons proved most convincing and instructive. In this case five different varieties of plums were grafted upon four different kinds of stocks, and very distinct modifications resulted, both from the influence of cion on stock and of stock on cion. These results have been reported from time to time in the publications of the Vermont experiment station.[1] The trees in this experiment were planted in orchard form on the grounds of the Vermont experiment station, where a number of them are still standing. Through the kind permission of the officers of that station (Director J. L. Hills and Horticulturist Wm. Stuart) the present writer has been enabled to renew his studies on the trees still living. During the summer of 1908 a large number of measure-

[1] Vermont experiment station report 13; pp. 333–354 (1900); 14; pp. 257–269 (1901); 15; pp. 249–260 (1902); 18; pp. 300–305 (1905).

ments were made by Mr. C. S. Pomeroy, then assistant in horticulture in the Massachusetts experiment station, and these measurements form the basis of the detailed comparisons following.

It will be proper to preface these notes further by saying that the measurements herein reported are arbitrarily confined to the one variety Milton, as grafted on (*a*) Americana stocks, (*b*) Wayland stocks, (*c*) Marianna stocks, (*d*) peach stocks. Other varieties cross-grafted on these same stocks showed substantially the same modifications.

Form of Leaf.

Critical examination shows that the trees were profoundly modified in many directions by the stocks on which they were grafted. One of the characters chosen for special study was the form and size of the leaf. The average size of leaves, taken from several hundred measurements, is shown in the following table: —

Length and Breadth of Leaves.

	Length (Millimeters).	Breadth (Millimeters).
On Americana, ...	72.05	27.20
On Wayland, ...	73.50	28.22
On Marianna, ...	74.40	34.02
On peach, ...	76.30	31.56

These measurements show at once the greater relative and positive breadth of the leaves of trees growing in Marianna stocks.

In order to show more clearly the variation in form, — a modification distinctly manifest to the eye, — measurements of breadth were taken not only at the middle of each leaf, but also at distances from the base equal to one-tenth the total leaf length and two-tenths and three-tenths the total length. Similarly, breadth measurements were made one-tenth, two-tenths and three-tenths of the leaf length from the tip. The numerical averages of these measurements need not be given here since the results may be so much more easily understood from the graphic

presentation in Fig. 1. Here the averages are presented as actual leaf forms, so that each diagram shows the average form of leaf in its respective class. Where it is understood that these averages are taken from a large number of measurements, and

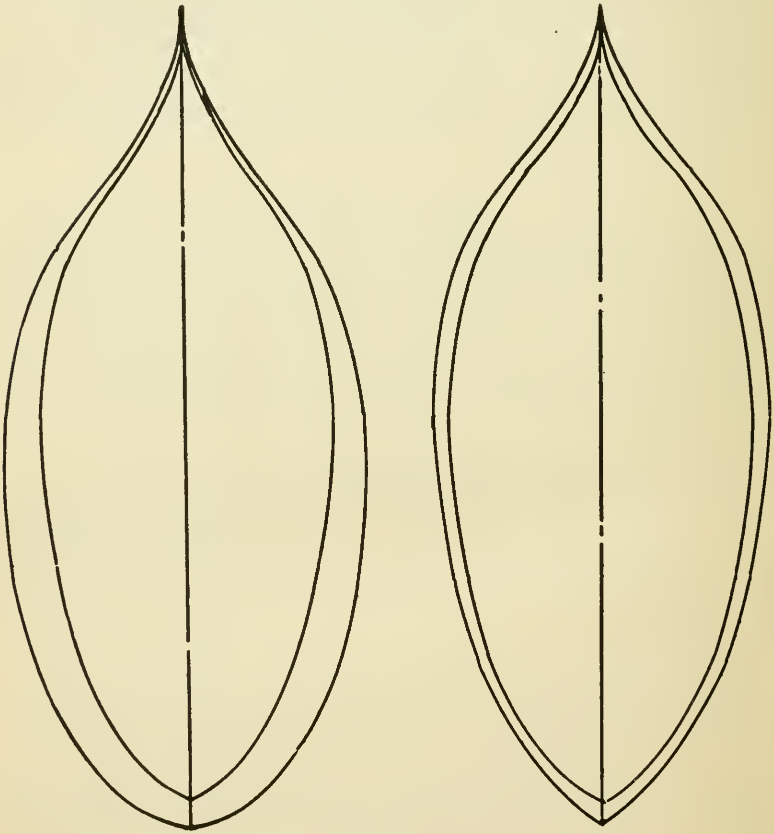

FIG. 1.

that the modifications are due, so far as can possibly be seen, solely to the influence of the stocks on which the trees are growing, it will be manifest that a distinct addition is made to the knowledge of this subject.

MARGINAL SERRATIONS.

Not only are the leaves in different lots different in size and form, but they differ also in color. This difference, though

easily demonstrated to the naked eye, cannot be so easily measured and recorded statistically. There is also a remarkable difference in the marginal serrations in leaves from trees on different stocks. Tracings of typical leaf margins are compared in Fig. 2. By measuring the length of a large number of leaf

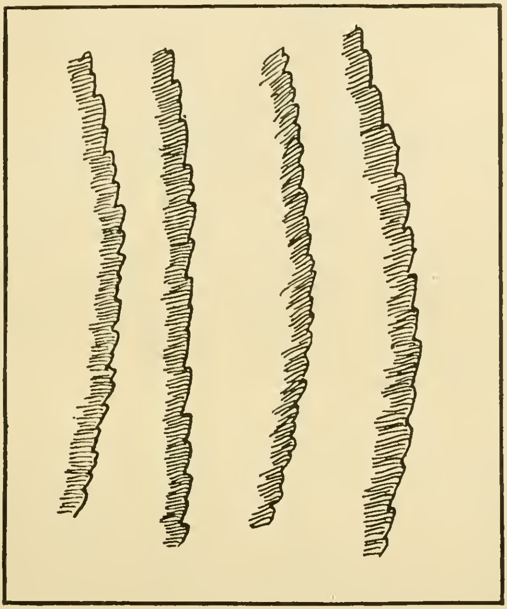

FIG. 2.

serrations in each lot, averages have been secured which will serve for numerical comparison. In order to secure these measurements with reasonable accuracy the leaf margins were considerably magnified. On this account the units used in the following comparison are arbitrary and need not be regarded. (They were approximately one-eightieth of an inch.)

Comparison of Marginal Serrations.

	Average.	Standard Deviation.
On Americana,	38.00	9.32
On Wayland,	35.08	8.11
On Marianna,	31.02	5.39
On peach,	34.75	6.65

The "standard deviation" shown in the right-hand column above will be easily understood by students of plant variation. Roughly, it may be taken as the average deviation from the mean.

The figures show, therefore, that the marginal serrations on Milton plum leaves are much larger and much more variable when Milton plum is worked on Americana stocks than when it is worked on Wayland, Marianna or peach. On Marianna the serrations are finest and least variable.

Now, leaf margin characters are generally taken by botanists to be of special importance in determining species and varieties. That is, they are thought to be relatively constant. Moreover, leaf margin characters are of special significance in the genus Prunus, to which all the true plums belong. These curious modifications, therefore, due almost certainly to the influence of the various stocks, show conclusively that such influences may be profound and far-reaching.

Rate of Growth.

The horticulturist will be more interested in the rate of growth than in marginal serrations. Here, also, the influences of the various stocks are traceable. Unfortunately, our measurements include only three of the stocks in the experiment, the peach being omitted. The average annual growth, taken in centimeters, together with the standard deviation, is shown below: —

Annual Growth.

	Average (Centimeters).	Standard Deviation (Centimeters).
On Americana, ...	103.45	35.62
On Wayland, ...	106.14	56.54
On Marianna, ...	149.30	57.90

It is seen at once that the annual growth of Milton plum on Marianna stocks is much greater than on Americana or Wayland, with somewhat greater variation. These averages, with their respective deviations, may be more convincingly shown, at least to students used to modern plant breeders' methods, by

representing them graphically. In Fig. 3 are shown three curves, each representing the variation in one of the lots measured for annual growth. These curves bring out more forcibly than the arithmetical averages the remarkable differences in

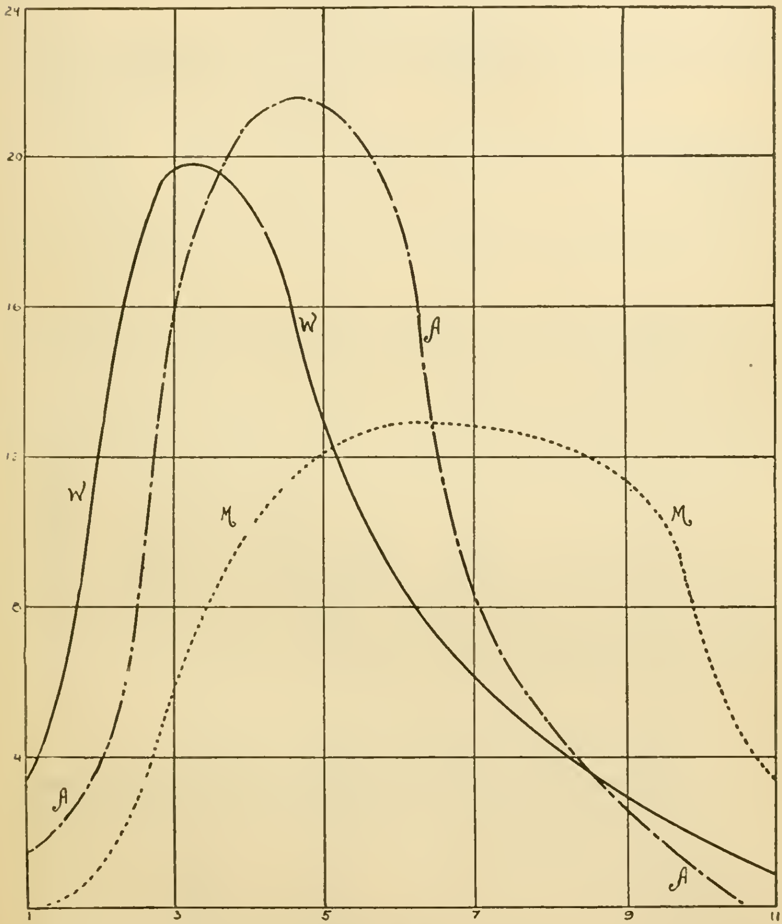

FIG. 3.

growth between the different lots, more especially between the trees on Marianna and those on the other two stocks.

Just in passing it may be observed that the two lots on Americana and on Wayland have behaved much alike in all respects from the beginning, while the lot on Marianna roots has shown the most marked changes.

The difference in growth may be shown further by the difference in the length of internodes (or joints) in the wood. A large number of measurements were made of the internodes of one-year-old wood, with the following results: —

Length of Internodes.

	Average (Centimeters).	Standard Deviation (Centimeters).
On Americana, ...	9.60	6.85
On Wayland, ...	10.92	8.87
On Marianna, ...	15.80	10.47

These figures show a much ranker, more vigorous growth in trees on Marianna stocks than on the others. There is also a greater amount of variation. The striking differences in the growth of internodes, however, are again shown most forcibly by representing all the measurements graphically, as is done in Fig. 4.

This difference in growth comes out in every point where measurements can be taken. For example, the diameter of a large number of branches was measured on two-year-old, on three-year-old and on four-year-old wood. The average measurements are shown below: —

Caliper Measurements of Branches (Centimeters).

	Two Years.	Three Years.	Four Years.
On Americana, ...	3.92	5.55	7.63
On Wayland, ...	3.90	5.19	7.25
On Marianna, ...	4.76	6.19	8.13

These measurements of the diameter of branches reveal once more the fact that Milton plum trees grow much more vigorously on Marianna roots than on Americana or Wayland.

SUMMARY.

These studies show, by careful and accurate measurements, and by more thorough methods than any hitherto applied to this subject, that distinct modifications do occur in plum trees due

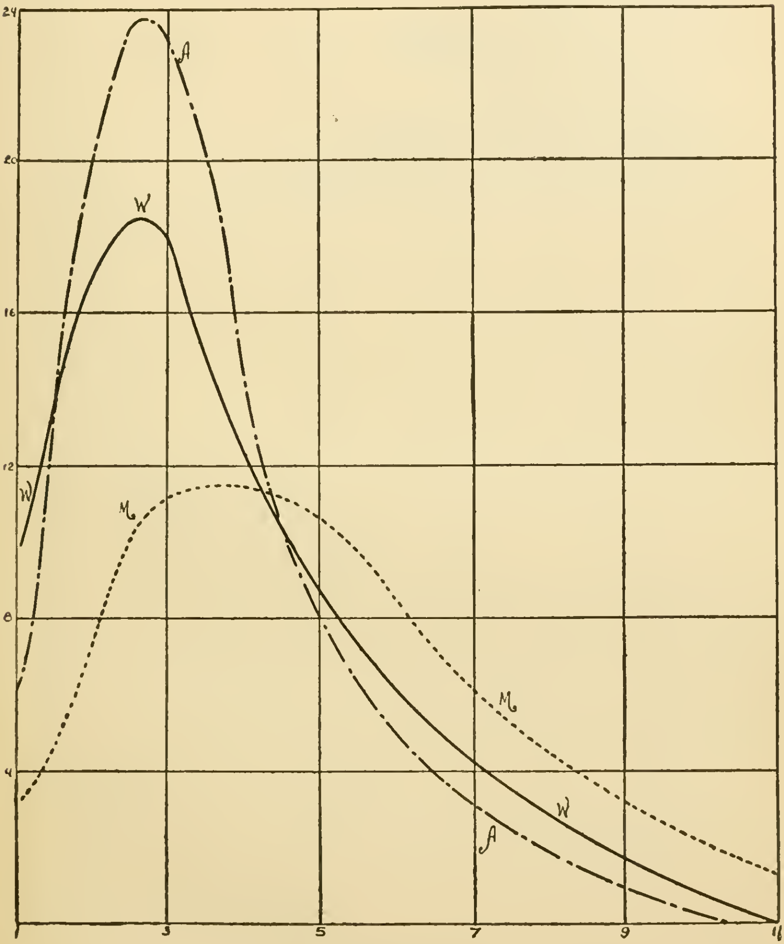

Fig. 4.

to the influence of the stocks in which they are grafted. These influences appear to extend to all characters of leaf, twig, habit of growth, etc. Unfortunately, the present writer has not been able to make equally careful observations of the fruit; but in

general terms it may be said that the fruit is modified also. The Marianna stock in particular seems to produce the most obvious changes in the growth of plums worked on it. In the experiments here under observation these changes are as follows: —

1. Broader leaves.
2. Finer marginal serrations.
3. Greater annual growth.
4. Larger internodes.
5. Greater diameter of branches.
6. Greater variability in all characters.

CATTLE POISONING FROM ARSENATE OF LEAD.

JAS. B. PAIGE, D.V.S.[1]

Ever since farmers began using arsenic compounds for the destruction of insect pests there has been considerable discussion as to the possibilities and probabilities of farm animals becoming poisoned from eating the poisoned foliage of the sprayed plants or the grass grown under trees that have been treated with arsenical preparations. This discussion began with the use of Paris green and London purple, used for the destruction of potato bugs and codling moths, and has more recently included the use of the many insecticides the most of which contain some form of arsenic. As early as 1889 Prof. A. J. Cook of the Michigan Agricultural Experiment Station, giving the results of extensive experiments to test the efficiency of Paris green, London purple and white arsenic as insecticides, in a paper read at the meeting of the Society for the Promotion of Agricultural Science at Toronto, says: "Thus we have demonstrated that the arsenites are effective against the codling moth, that in their use there is no danger of poisoning the fruit, and when used properly no danger to the foliage nor to stock that may be pastured in the orchard."

With the advent of arsenate of lead as an insecticide, in 1893, the question arose as to the dangers to stock pastured in fields where this insecticide had been used, or of the dangers of using the hay from such fields.

In "Agriculture of Massachusetts" for 1897 Mr. A. H. Kirkland, a scientist in the employ of the Gypsy Moth Commission of the State Board of Agriculture, reported a single experiment with a horse, to determine if there was danger to ani-

[1] Albert L. Whiting, of the class of 1908, had charge of the animals and attended to the feeding of the arsenate of lead while the experiment was in progress.

mals that ate the grass taken from under trees that had been sprayed with a strong mixture of arsenate of lead. The experiment consisted in taking sufficient grass for two large feeds for a horse and spreading it under a pear tree that was later sprayed with a liberal quantity of arsenate of lead, in the proportion of 20 pounds to 150 gallons of water. Not satisfied that the amount of the mixture dripping from the tree on the grass was sufficient to make the test conclusive, the grass was thoroughly drenched with the mixture direct from the nozzle of the spraying machine. The treated grass was fed to a 1,200 or 1,300 pound horse during the afternoon and evening of the same day that it was sprayed. Two days later the animal was found to be well and hearty, and reported by the teamsters to be in better condition than before the grass had been eaten. The burning effect of the spray upon the foliage of the pear tree proved that there was considerable soluble arsenic present, which would render the arsenate of lead much more poisonous to animals than a properly prepared arsenate of lead that contained but little soluble arsenic.

During the past two or three years, since the revival of the gypsy moth work in the eastern part of the State, numerous letters received at the experiment station, as well as newspaper articles and reports from veterinarians, have suggested that farm animals were being poisoned from the ingestion of grass and foliage of shrubs sprayed with arsenate of lead, used in the destruction of the gypsy moth.

To determine whether or not this was the case the experiment station began a series of experiments in 1907 to ascertain what effect arsenate of lead would have upon cattle when given in small doses for a long time or when given in large single doses.

The cattle used in the experiment were animals that had been condemned as tuberculous by the inspectors of the Cattle Bureau of the State Board of Agriculture. These were placed at the disposal of the experiment station by the courtesy of Dr. Austin Peters, Chief of the Cattle Bureau, and were in every instance subjected to a careful post-mortem examination, to note the effects of the arsenate of lead and to determine whether or not tuberculosis was present.

The arsenate of lead used in the experiment was manufac-

tured by the Bowker Insecticide Company of Boston, and sold under the trade name of Disparene. Its composition, according to John P. Street of the Connecticut Experiment Station, Bulletin No. 157, September, 1907, is as follows: —

Original Material.

Water,	46.47
Arsenic oxide (AS_2O_5),	13.87
Lead oxide (PbO),	35.11
Soluble impurities (other than AS_2O_5 PbO),	4.34
Insoluble impurities (by difference),	.21
Soluble arsenic oxide,	.39
Water Free: —	
Arsenic oxide (AS_2O_5),	25.91
Lead oxide (PbO),	65.59
Total impurities,	8.50

Before the actual feeding of the arsenate of lead was begun all available literature thought likely to give some information bearing on the experiment was reviewed, but nothing of importance other than that already mentioned was discovered to indicate the probable poisonous dose, the effects of administration or the pathological changes produced. The fact that the compound is a comparatively new one (1893), and is used almost exclusively as an insecticide, probably accounts for the absence of any mention of it in the latest works on toxicology. Even "Merck's Index" for 1907 fails to include it in its list of drugs and chemicals.

As previously mentioned, the experiment was carried on to determine the effects produced by long-continued administration of small doses of the compound, such as an animal might get by eating for a long time foliage, grass or hay carrying but limited quantities of the arsenate of lead, and the effects of large amounts given at one dose.

Five mature cows were used in the experiment, that were designated by the numerals 1 to 5. For purposes of reference the details of the experiment with each animal are published in full. A general summary follows the details.

Record of No. 1 (Red Grade).

November 16, weight 600 pounds; November 23, weight 597 pounds.

DATE.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
1907. Nov. 12 to Dec. 1, .	1	In grain, .	20	- -	November 26 samples of milk and urine taken for analysis.
Dec. 1 to Dec. 4, .	1	On rowen, .	3	- -	- -
Dec. 4 to Dec. 8, .	1	In potato, .	3	Off feed.	- -
Dec. 8 to Dec. 12, .	-	-	-	Refused all food,	Paraplegia developed and continued until time of death.
Dec. 12 to Dec. 14,	1	In beet and apple.	3	Purging violently; feces bloody and coated with mucus.	- -
Dec. 14 to Dec. 22,	-	-	-	Refused food and water.	Died at 10.30 A.M.
			29		

December 23, 9.30 A.M., autopsy. Principal lesions: lungs extensively tuberculous; extensive fibrous inflammation of serous coat of first stomach; small intestines engorged with dark blood but free from evidences of inflammation, such as infiltration, or presence of bloody exudate on mucous surfaces; liver enlarged and filled with dark blood. The muscular tissue under skin showed numerous ecchymoses.

When first brought to the veterinary hospital, although in fair flesh, the animal showed fairly well-defined physical symptoms of pulmonary tuberculosis; with the development of the disease there was a gradual loss of weight. The loss of appetite, violent purgation and paraplegia were evidently due to poisoning with the arsenate of lead.

A chemical analysis of small samples of milk and urine taken on November 26, after 15 grams of lead arsenate had been administered, failed to reveal the presence of either lead or arsenic.

Record of No. 2 (Jersey).

November 16, weight 540 pounds; November 23, weight 545 pounds.

DATE.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
1907. Nov. 12 to Dec. 15,	.5	In grain, .	16.5	Off feed; slight paraplegia.	From November 23 there was a gradual loss of weight.
Dec. 19, . .	-	-	-	Purging violently; eating a small amount.	- -
			16.5		

December 23, owing to emaciation and paralysis, animal was killed, and autopsy held. Principal lesions: lungs badly tuberculous; mucous

membrane of fourth stomach thickened, infiltrated and reddened. Portions of liver, kidney and spleen submitted to chemical examination were found to contain an abundance of lead and traces of arsenic.

Record of No. 3 (Collins Shorthorn).

December 14, weight 1,015 pounds. Dry, and not in calf.

Date.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
Dec. 14, 1907, to Jan. 18, 1908,	2	In grain, on rowen and in gelatine capsule inside roots.	76	- -	Normal respiration deep and labored.
1908. Jan. 18 to Feb. 4,	3		51	- -	Increase to 3 grams caused no noticeable change.
Feb. 4 to Feb. 10,	4	Capsule in roots.	24	Slightly off feed and purging.	Repeated attempts made to increase dose to 3 or more grams, without success.
Feb. 10 to Feb. 16,	2	Capsule in roots.	14	Violent purging, continuing to February 27. Feces liquid and tinged with blood at times.	February 15 to 20 little or no food or water taken.
Feb. 16 to Mar. 22,	-	-	-	February 27, less purging; appetite returning; March 1, taking nearly full amounts of feed and water.	Improvement in flesh and spirit quite marked; unsteadiness and inclination to remain recumbent quite noticeable; continued throughout experiment.
Mar. 22 to Mar. 24,	3	Capsule in roots.	6	- -	- -
Mar. 25, . .	1½	Capsule in roots.	1½	- -	- -
Mar. 26 to Mar. 27,	3	Capsule in roots.	6	- -	- -
Mar. 28, . .	1½	Capsule in roots.	1½	- -	- -
Mar. 29 to Apr. 4,	-	-	-	Refused food and water.	- -
Apr. 5 to Apr. 6, .	2	Capsule in roots.	4	- -	- -
Apr. 6 to May 19, .	-	-	-	- -	April 25, sample of urine collected for chemical analysis; May 4, feeding well; May 18, all food withheld.
May 19, . . .	50.4	On hay, .	50.4	- -	Ten pounds of hay sprinkled with mixture of 56 grams of arsenate of lead in water; allowed to dry, then fed in two portions; all but 1 pound of hay eaten.
May 20, . . .	-	-	-	Off feed and purging.	- -
May 21 to June 1,	-	-	-	Violent purging; feces liquid and bloody; refused to eat or drink to any extent.	- -
June 1 to June 8,	-	-	-	Feces approaching normal; still refuses food and water.	- -
			234.4		

Animal killed June 8, 1908; autopsy at time of slaughter. Body fairly well nourished, weight 900 pounds (estimated). No external lesions except on prominent parts that came in contact with the cement floor. About one pail full of watery material, brown in color, escaped from mouth after death. An abundance of fat found on removal of skin; muscle tissue red in color and well developed. On opening abdominal cavity no alterations found. Urino-genital organs normal in size and texture. Bladder contained about one pint of straw-colored urine. Kidneys firm, and gross portions represented nothing abnormal. Ureters pervious. First, second, third and fourth stomachs all contained food material in abundance, consisting of well-masticated hay and grain. First and fourth stomachs contained an abundance of watery fluid; second stomach contained 15 to 20 shingle nails, somewhat eroded; contents of third stomach not as dry and hard as usually found, still sufficiently firm to retain shape when removed from organ. Mucous membranes firm and adherent in all parts; that of the fourth stomach slightly reddened. Intestines, both large and small, smooth and glistening on outer portion; walls not thickened but somewhat reddened. Mucous membrane firm and dark in color. Contents thin and semifluid. Liver dark red, firm and well filled with blood. Vessels open. Gall bladder large and distended with one quart of dark green, ropy bile. Bile duct pervious. Spleen firm and free from any gross lesions. Lymphatics and blood vessels of the abdominal cavity showed no abnormalities. Thoracic cavity, heart and lungs free, and pleural surfaces smooth and glistening. Lungs light and puffy and of a dark pink color. On manipulation six or eight hard areas, size of English walnut, found in lung substance. On section these hard areas were found to contain yellow caseous material, surrounded with thick wall of fibrous tissue. Lungs on section found filled with air. Air tracts contained some frothy material. Pericardium smooth and normal in thickness; on section found to contain one ounce of serous fluid. Heart muscle firm and uniformly red in color. Little blood present in any of the cavities. Bronchial and mediastinal lymph glands size of English walnuts, hard and firm, and on section dotted throughout with yellow areas and distinctly calcareous. Trachea and œsophagus normal. Mouth contained about one pound of coarse, partially masticated hay, apparently returned from stomach at or shortly prior to time of death. Tongue, teeth and throat organs free from lesions.

Diagnosis: tuberculosis and slight gastro-enteritis.

Temperature Chart of No. 3 (Collins Shorthorn).

One week, February 24 to March 1.

Date.	Temperature (Degrees F.) and Time of Day.					Pulse.
1908.	7 A.M.	11.30 A.M.	4 P.M.	6 P.M.	10 P.M.	
Feb. 24,	–	100	–	101.3	–	50, weak, thready.
Feb. 25,	100.3	–	101.3	–	102	46, weak, soft.
Feb. 26,	102.3	–	–	103.0	–	54, weak, thready.
Feb. 27,	103.2	–	–	102.0	–	55, weak, thready.
Feb. 28,	101.0	–	–	102.0	–	–
Feb. 29,	–	–	–	100.2	–	–
Mar. 1,	–	–	–	101.2	–	–

Record of Tuberculin Test of No. 3 (Collins Shorthorn), May 3 and 4.

Normal Temperature (Degrees F.), 10 P.M.	U. S., B. A. I. Tuberculin, 10 P.M.	Temperature (Degrees F.) after Injection.							
		A.M.			P.M.				
		6.30	8.30	10.30	12.30	2.30	4.30	6.30	8.30
101.4	2 c. c.	104.3	105.2	105.2	103.2	105.1	106.1	105	104.4

Record of No. 4 (Black Jersey).

January 18, weight estimated at 600 pounds. In fair flesh, giving liberal quantity of milk. Slight physical symptoms of tuberculosis.

Date.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
1908.					
Jan. 18,	28.35	In gelatin capsule.	28.35	– –	Dose administered as pill at 9.45 A.M.
Jan. 19,	–	–	–	Purging; feces thin and much mucus present.	– –
Jan. 20,	–	–	–	Violent purging; feces bloody; milk decreased. Temperature 11 A.M. 101.1; 7 P.M. 102.	– –
Jan. 21,	–	–	–	Feces approaching normal. Temperature 11 A.M. 101.4; 7 P.M. 101.2.	– –
Jan. 22,	–	–	–	Recurrence of purgation; eating and drinking but little. Temperature 11 A.M. 102; 7 P.M. 102.	– –
Jan. 23,	–	–	–	Less purging; milk flow slightly increased. Temperature 6.30 P.M. 101.3.	– –

Record of No. 4 (Black Jersey) — Concluded.

Date.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
1908.					
Jan. 24,	-	-	-	Little or no purgation; appetite improving.	- -
Jan. 25 to Mar. 22,	-	-	-	Gradual improvement from day to day.	- -
Mar. 22 to Mar. 26,	2.00	In grain,	8.00	- -	- -
Mar. 26,	1.00	In grain,	1.00	- -	- -
Mar. 27 to Apr. 19,	2.00	In grain,	48.00	- -	- -
Apr. 19 to Apr. 22,	-	-	-	- -	Milk taken for chemical analysis.
Apr. 22 to Apr. 24,	2.00	In grain,	4.00	- -	- -
Apr. 24,	1.00	In grain,	1.00	- -	Urine taken for analysis.
Apr. 25 to May 3,	2.00	In grain,	16.00	- -	- -
May 3,	1.00	-	1.00	- -	Tuberculin tested.
May 4,	-	-	-	- -	- -
May 5 to May 17,	2.00	In grain,	26.00	- -	- -
May 18,	-	-	-	- -	All food withheld.
May 19,	19.80	On hay,	19.80+	- -	Ten pounds of hay drenched with mixture of 28.35 grams of lead arsenate in water, allowed to dry and fed in two portions, morning and night; three pounds not eaten.
May 20 to May 28,	-	-	-	Passing dark, bloody, liquid feces; refuses food and water, except small quantities of grain and a very little water near last date; purgation very slight on 27 and 28.	From time arsenate was given in small doses animal unsteady on hind legs and inclined to remain lying much of the time.
			153.15+		

May 28 animal slaughtered and autopsy made. Principal lesions: small tubercular nodule in lobe of lung; indications of the irritant and poisoning action of arsenate of lead few. Blackening of the gums about the incisor teeth quite pronounced in this animal; not found in any of the others.

Record of Tuberculin Test of No. 4 (Black Jersey), May 3 and 4.

Normal Temperature (Degrees F.) 10 P.M.	U. S., B. A. I. Tuberculin.	Temperature (Degrees F.) after Injection.						
		A.M.			P.M.			
		6.30	8.30	10.30	12.30	2.30	4.30	6.30
102	2 c. c.	105.3	108	106.2	106.3	106.3	106.3	105.4

Tuberculin tests were made by senior students of veterinary class.

Record of No. 5 (Fawn Jersey).

February 24, weight 600 pounds (estimated).

Date.	Grams per Day.	How given.	Total in Grams.	Symptoms.	Remarks.
1908. Feb. 24, . .	56.70	In capsule, .	56.70	–	Dose given as pill at 11.30 A.M.

On February 25, during early part of forenoon ate considerable hay and grain. At night all food and water refused. Purgation violent; feces liquid and contained liberal quantities of blood and mucus; blood clots abundant.

On February 26, early morning, marked shivering of body muscles; unsteady on feet, more especially hind feet; breathing deep, labored and stertorous. During the morning marked symptoms of paraplegia appeared, which became so aggravated that animal at times had great difficulty in maintaining standing position. Toward evening all of the above symptoms were more marked, and those of intestinal pain became prominent, such as stepping about uneasily, looking at the flanks, switching of the tail, moaning, etc. Throughout the night of the 26th and the early morning hours of the 27th the symptoms of intestinal irritation, pain and paralysis became more pronounced. Purgation continued to the time of death. There was but a small amount of urine passed. Death occurred at 9 o'clock on the morning of the 27th.

Autopsy six hours after death. No lesions of external parts except on withers, where there were found two or three surface abrasions. Animal six or seven years old, body somewhat emaciated, estimated weight 550 to 575 pounds. On removal of skin only a moderate amount of fat found; muscles poorly nourished and dark in color. All surface veins distended with dark, slightly clotted blood. Muscle and subcutaneous tissues corresponding in location to surface lesions on withers, dark in color and infiltrated with blood and serum. Submaxillary lymphatic gland on right side the size of a large orange. On section,

enclosed in fibrous walls three-eighths of an inch in thickness was one ounce of thick, yellow, creamy pus. Two post-pharyngeal lymphatic glands enlarged to size of small orange, hard and tense, and on section found to contain infiltration of yellow caseous material, slightly calcareous.

On opening the abdominal cavity but a small amount of fluid found (one or two ounces). No foreign material or displacements observed. Serous surface of second stomach reddened and slightly coated with fibrinous exudate. On opening first stomach an abundance of moist, yellowish-green food material, consisting of well-masticated hay and grain, was found. Mucous membrane adherent and light in color. On section of second stomach it was found to contain little or no food material; the mucous membrane was moist, thickened and gelatinous, due to an infiltration with bloody, fibrinous exudate. The third stomach was full of ingesta, well distributed between the leaves and of normal consistence. Mucous membrane throughout slightly thickened and red in color. The fourth stomach somewhat distended, the serous covering showing superficial blood vessels filled with dark blood. On section, contents fluid and blood stained. The small intestines externally were reddened and slightly ecchymotic. Mucous membrane injected with dark blood, thickened and gelatinous. Intestinal contents fluid, having the color of a mixture of chocolate and milk. The serous and mucous surfaces of the large intestines were free from any lesions, the contents moist and dark in color. Only a moderate amount of ingesta present.

The liver, apparently normal in size, presented a smooth, glistening surface with well-rounded borders. The consistence was normal. The incised surfaces were moderately dark in color, with ducts free and open. The gall bladder contained about two ounces of liquid bile, green in color. Gall duct pervious. Spleen surface smooth and glistening, firm to the touch. On sectioning cut surfaces reddish brown in color, with stroma and pulp apparently normal.

The kidneys were firm in consistence, with the capsule free and detachable. The internal portion appeared normal, the medullary and cortical parts distinct and unchanged. Ureters pervious. Bladder empty and contracted. Membrane pale.

The thoracic cavity contained a few ounces of serous fluid. Lungs not adherent to chest wall. Lung surfaces smooth and moist, free from fibrous exudate. On palpation several small hard areas were discovered scattered throughout the lung substance. On section the tissue was found red in color, and contained considerable quantities of dark blood. The bronchi and bronchial tubes contained small amounts of frothy material. The hardened portions found on palpation were found to consist of masses of caseous material enclosed in fibrous walls. On cutting these tumor-like masses there was evidence of calcareous infiltration. The bronchial and mediastinal lymphatic glands were

enlarged and streaked with yellow caseous matter, and somewhat calcareous.

The pericardium externally was free from evidences of inflammation and contained one-half an ounce of serous fluid. Heart muscle firm and red in color. The cavities of the left side contained small clots of dark blood, those of the right side were empty. Valves smooth and white. The trachea, larynx, pharynx, tongue, oral and nasal cavities were free from lesions.

Diagnosis: tuberculosis and acute gastro-enteritis.

Chemical Analyses.[1]

As indicated in the tabulated records, several samples of material from different sources were collected for chemical examination, to determine the presence or absence of either of the essential constituents of arsenate of lead.

From cow No. 1 both urine and milk were analyzed after the animal had received, in small daily doses, 15 grams of the arsenate. Neither arsenic nor lead was present. It should be noted in connection with this analysis that only a few ounces of urine and milk were sent for examination. At the suggestion of the chemist, in the collection of all later samples larger amounts of material were taken.

From cow No. 2 were furnished samples of tissue, consisting of portions of the liver, kidneys and spleen. The parts from the different organs were analyzed as a composite specimen, which was found to contain abundance of lead and traces of arsenic.

From cows Nos. 3 and 4 samples of milk and urine were taken on April 22, 24 and 25. No. 3 had been receiving small doses of the arsenate since December 11, and had taken a total of 184 grams. No. 4 supplied both milk and urine for analysis. She had received one dose of 28.35 grams on January 18, and several smaller doses subsequently aggregating in all 90.35 grams. Under date of May 29, 1908, the chemist reported on the three specimens as follows: —

The sample of milk forwarded by you on the date of April 23, for a lead and arsenic test, has been analyzed. Neither of these poisons was found present in sufficient quantities to detect it by ordinary

[1] These analyses were made at the experiment station laboratories by H. D. Haskins, in charge of the Fertilizer Division.

chemical methods. The two samples of urine also submitted for lead and arsenic tests have been analyzed. Both of these samples showed a reaction for lead and arsenic, but not to the extent that I had anticipated; only small quantities of either of these poisons were found present. I did not attempt a quantitative determination in either case, but should judge that the sample from the red cow (No. 3) showed the larger amounts of both arsenic and lead.

The fact that a young calf, to which large quantities of the milk of cow No. 4 were fed, showed no symptoms of illness, is further evidence that arsenic and lead were not present in the milk.

Brief Summary of Symptoms.

Chronic Poisoning. — Loss of appetite, refusal of water, purgation, with feces liquid and nearly black in color, containing an abundance of mucus and blood, the latter either disintegrated or in clots, suppression of urine, progressive paraplegia, emaciation, with hair harsh and rough. There appears to be but little disturbance of the temperature functions, the maximum reading obtained being only 103.2° F. The pulse becomes somewhat accelerated and of a thready character, but is not sufficiently altered to constitute an important symptom. There is dullness of the eye and general indications of depression when the symptoms enumerated above are most in evidence, but with the elimination of the poison from the system there is a gradual return of the normal body functions, as indicated by a cessation of purgation and a return of the appetite.

Acute Poisoning. — Attack sudden, characterized by shivering, refusal of food and water, back arched, skin dry and harsh, hair erect, abdominal pain, slight elevation of temperature, pulse thready and increased to 55 or 60 beats per minute, respirations accelerated and difficult. Following these symptoms in quick succession is purgation, with feces abundant, watery, dark in color and bloody. The urine is scanty and passed only at long intervals. Paresis develops early, with the other symptoms, and is progressive, affecting the posterior portions of the body most. At this stage of development of the symptoms the head is moved about nervously, the eyeballs are retracted and glassy, there is more or less champing of the jaws, and at irregular intervals the animal suffers from convulsions, from which it

falls and struggles violently. In fatal cases purgation continues, the pain becomes intense, the expression of the face more anxious, pulse faster and weaker, paralysis more marked and the convulsions more frequent and severe. Partial coma precedes death. In this stage the symptoms are less urgent, and there may be involuntary passage of urine and regurgitation of material from the stomach.

A comparison of the symptoms of acute and chronic poisoning with arsenate of lead with those of arsenic and lead, as given for cattle in Nunn's "Veterinary Toxicology," indicates that when the arsenate of lead is given the symptoms are a combination of those enumerated under both arsenic and lead poisoning. The lesions found upon post-mortem examination are perhaps to be attributed more to the action of the arsenic than the lead, particularly so in chronic cases, in which no indications of the fatty degenerations of chronic lead poisoning were observed.

Diagnosis. — The symptoms of arsenate of lead poisoning are not sufficiently unlike those of poisoning with other similar compounds, such as the salts of copper, antimony, zinc, etc., to render a diagnosis probable without a previous history of the animals having had access to the arsenate of lead in some form. With this previous history to assist and suggest the clew, in conjunction with the symptoms, a correct diagnosis should be made without difficulty.

The post-mortem findings are not sufficiently characteristic to insure a positive diagnosis without recourse to a chemical examination to prove the presence of the arsenic and lead.

Prognosis. — A careful study of the details of the experiments with the five cows, already given, shows that one should be exceedingly careful in giving a prognosis. Even in those cases in which the drug was administered in large quantities, and the symptoms became very urgent and pronounced, there was a recession of them, and a return to a condition of health after a period of convalescence of variable duration. In the cases in which there was an administration of small quantities of the compound for a long period of time, and a full development of symptoms of a serious character, there was not a fatal termination. If on account of a partial nonsusceptibility, or a rapid elimination of the lead and arsenic from the system, death

does not follow shortly after the full development of the symptoms of purgation, paresis, abdominal pain, etc., a favorable prognosis may be given.

Treatment. — In these experiments no attempts were made to discover new means of treatment, or to try those already used, to overcome the poisonous effects of either lead or arsenic. The appearance of the symptoms of both lead and arsenic poisoning would indicate the use of a combination of the antidotes ordinarily employed in the treatment of arsenic and lead poisoning cases, together with such means as would tend toward prevention. For the latter, the discovery and removal of the source of the compound is all that is necessary. In the treatment of animals in which the symptoms are urgent, indicating acute poisoning, administration of those things that afford mechanical protection to the mucous membranes is indicated, such as mixtures composed of wheat flour, linseed meal, slippery elm, milk, eggs, etc. To render the unabsorbed lead or arsenic contained in the stomach insoluble or inert, sulfate of magnesia, sodium sulphide or flowers of sulphur may be given to act upon the lead, and peroxide of iron, dialized iron or hydrated magnesia to act upon the arsenic. Little can be done to counteract the action of the lead or arsenic that has already become absorbed into the blood. The poisonous effects of that absorbed are to be counteracted by general treatment having a tendency to prevent heart failure, etc. The hypodermic administration of atropine and nitroglycerine may be employed. To hasten the elimination of the poisons from the system, saline purgatives in small doses and mild diuretics should be used. In those cases of chronic poisoning, where lead has accumulated in the tissues, the administration of iodide of potassium in small, frequently repeated doses favors the elimination of it with the bile and urine. The paroxysms of colic should be relieved by hypodermic administration of morphia or the oral administration of chloral.

Liability of Poisoning. — Having demonstrated the possibilities of producing poisoning in cattle by giving arsenate of lead, the question naturally arises as to the probabilities of its happening in localities where this substance is used in liberal quantities as an insecticide. Manufacturers of arsenate of lead and entomologists recommend using about 3 pounds to 100 gal-

lons of water for spraying. Mr. A. H. Kirkland has told me that frequently, for the destruction of gypsy moths, mixtures of 20 to 25 pounds of arsenate of lead to 100 gallons of water are used, and that it is applied either as a spray or a stream from the machines, depending largely upon the height of the trees that are being sprayed. Where the moths are numerous, and are found upon the foliage of shrubs in wood lands, these as well as the trees are sprayed. The amount of drip from sprayed trees depends very largely upon how the arsenate mixture is applied. If applied in the form of a spray, with care, less escapes from the foliage to the ground or grass beneath the sprayed trees than when applied in a stream. During the past summer the writer visited several sections in the gypsy moth district, and observed that the foliage of shrubs under trees that had been sprayed some weeks before still had a sufficient amount of arsenate of lead adhering to be easily seen by the naked eye, and was informed by one engaged in the moth work that it adhered to the foliage so tenaciously that sufficient remained after several heavy rains to kill the caterpillars.

It is at once apparent that the amount of the poison used in spraying that will accumulate upon the grass under sprayed trees will vary very greatly according to the method of application, the velocity of the wind and other circumstances, and could hardly be expected to be the same in two cases of treatment.

As stated in Bulletin No. 131 of the Colorado Experiment Station, "Arsenical Poisoning of Fruit Trees," by Dr. Wm. P. Headden, all of the arsenate applied to the foliage must eventually reach the ground, either by being washed by rains from the leaves or carried with them when they fall from the tree. Three sprayings in a season, using 10 gallons of a mixture of 6 pounds of the arsenate to 100 gallons of water for a tree, mean that eventually there will find its way to the soil 1.8 pounds of pasty lead arsenate, equivalent to .9 of a pound of dry arsenate.

A mixture of 10 pounds of arsenate of lead to 100 gallons of water contains 45.3 grams of the arsenate to the gallon. In the case of cow No. 1, 29 grams, administered at the rate of a gram per day, produced violent symptoms of poisoning. With animal No. 2, 16.5 grams, given in daily doses of one-half gram per day, caused violent purging, loss of appetite and paresis. No. 3 took

151 grams in 2, 3 and 4 gram doses daily before equally marked symptoms of poisoning appeared. With No. 4, 28.35 grams given at one dose in capsule at 9.45 A.M. produced toxic effects in less than twenty-four hours, from which the animal did not recover completely for six or seven days. In the case of No. 5, 56.70 grams caused death in sixty-nine and one-half hours. A study of the records of the five animals shows that frequently repeated small doses of the arsenate have the same effect in the end as do large non-fatal doses given at one time. In feeding the lead arsenate paste it was found necessary to adopt every conceivable means to induce the cows to take it after a few doses had been given. At first when mixed with the hay or grain it was readily eaten, but after a short time the animals would carefully separate every particle of the paste from the hay or grain and leave it uneaten. It was for this reason that it was found necessary to conceal it in capsules enclosed in pieces of roots to insure its being eaten. When the hay that had been drenched with 1 and 2 ounces of lead arsenate in water was allowed to become thoroughly dried, it was readily eaten by the cows that had previously refused the fresh paste, even when thoroughly mixed with hay and grain, or enclosed without capsule inside of pieces of roots and apples. The fresh arsenate had an odor of acetic acid that was not noticeable in that contained in the dried hay.

To determine approximately how much hay would become covered with the drip in the spraying of a medium-sized tree the grass was cut on an area 35 feet in diameter under a tree near the veterinary hospital, thoroughly hayed and weighed. It was a moderately heavy growth of herds grass and weighed when dried 50 pounds. Allowing for a drip of 1 gallon in 10 of a mixture of 10 pounds of the arsenate to 100 gallons of water, each 10 pounds of the total of 50 would carry 9.06 grams of the arsenate paste, or practically one-half of that amount of the dried arsenate.

It would hardly be expected, taking into consideration the results obtained by feeding carefully weighed amounts of the arsenate, that a 10-pound feed of such hay would produce serious effects, but the continuous feeding of it for several days in succession would certainly do so, and judging from the experience

had in the feeding of treated hay animals would eat sufficient to cause fatal poisoning.

Susceptibility. — In so far as it was possible to ascertain there did not appear to be among the animals used in the experiment an individual susceptibility to the action of the poison. In some of the cows more was required to produce toxic effects than in others, but this seems to be accounted for more on the ground of weight and vigor than on that of individual susceptibility.

It is of interest to note in this connection the effect of arsenic or lead on the different species of farm animals. Nunn, quoting Kaufmann, gives the toxic dose of arsenic for each of the domestic animals, when administered by the mouth, as follows: —

	Grams.
Horse,	10 to 45
Ox,	15 to 45
Sheep,	5
Dog,	.1 to .15
Pig,	.5 to 1
Fowl,	.1 to .15
Pigeon,	.5

For acetate of lead the toxic dose, according to the same authority, is: —

	Grams.
Horse,	500 to 750
Cattle,	50 to 100
Sheep,	30
Pig,	8
Dog,	10 to 25

The harmless effects of the arsenate of lead fed to a horse by Mr. Kirkland, referred to in another part of this bulletin, is in all probability to be accounted for, in part at least, by the natural nonsusceptibility of the animal to the action of lead, to which the ruminants appear to be particularly susceptible.

THE PERIODICAL CICADA IN MASSACHUSETTS.

BY C. W. HOOKER.

The old order of cicadæ includes some five hundred members, and of these North America has her full share, more than one hundred being represented. Four species are commonly found in Massachusetts: *Cicada septendecim* L., the periodical cicada, or seventeen-year locust; *Cicada canicularis* Harr., the dogday harvest fly; *Cicada sayi* and *Cicada linnei*. Recent investigation by Smith and Grossbeck has shown that what have been called *Cicada pruinosa* Say and *Cicada tibicen* L. are really two altogether different species, which they have named *Cicada sayi* and *Cicada linnei*. Two others, *Cicada rimosa* Say and *Cicada* (*Tettigia*) *hieroglyphica* Say, also occur in Massachusetts, but are not common. *Cicada septendecim* L. comes every seventeen years about the first of June, while the rest are seen every year, *Cicada canicularis* coming with the beginning of dogdays, *Cicada linnei* a little later and *Cicada sayi* in August.

The periodical cicada — *Cicada septendecim* L. — is peculiarly colored and may be easily recognized. The eyes, legs and larger veins of the wings are of a peculiar reddish-yellow or orange color, the abdomen is marked with bands of the same color, and the rest of the body is jet black. The other cicadas of Massachusetts have in common a general greenish-brown color above and whitish below, but can be readily distinguished by the descriptions of Smith and Grossbeck in "Entomological News" (April, 1907, pp. 116–129).

The periodical cicada is known to occur quite generally through all that part of the United States east of the Rocky Mountains. None have been taken in Maine or New Hampshire, and only two occurrences are recorded in Vermont. There is a specimen, however, in the collection of the Massachusetts

Agricultural College which is labelled Orono (Me.), in the handwriting of Prof. C. H. Fernald; but Professor Fernald has no recollection of it, and is of the opinion that it probably came from some other place, for this would be the only known case of its occurrence in that State. The rest of New England has parts of several well-defined broods which are more or less important. There are now, in all, according to the latest enumeration — Marlatt — thirty broods, — seventeen seventeen-year broods, with a general northern distribution, and thirteen thirteen-year broods, which occur in the southern States.

Massachusetts has the honor, or misfortune, of possessing the earliest known record — 1633 — of the occurrence of the periodical cicada. Yet even then the Indians were well acquainted with this periodical visitor, using it as food, and it has probably been used in like manner for centuries. Massachusetts is credited with four broods, and a fifth, just beyond the southwestern boundary, from which members have probably entered the State, though none have been actually reported. These can be easily located from the following table: —

Marlatt Numbers.	Year next due.	Occurrence in New England.	Riley Numbers.	Walsh-Riley Numbers.	Fitch Numbers.	Smith's Register.
II., .	1911	New York and Connecticut near Massachusetts State lines.	XII.	VIII.	1	1843
VIII., .	1917	Dukes, ...	XX.	XIV.	2–8	1849
X., .	1919	Bristol, Rutland, Vt., . .	XXII.	XVI.	4	1851
XI., .	1920	Bristol, Franklin, Hampshire (Mass.), Connecticut, Rhode Island.	I.	I.	9	1852
XIV., .	1923	Barnstable, Plymouth, . .	VIII.	VI.	3	1855

1855. (Riley, VIII.) Brood XIV.

Barnstable, Plymouth. (1906.) 1923.

Occurrence.

Plymouth, 1633; Manomet Point, Wareham, Onset, Sandwich to Dennis, 1770 to 1906.

This brood occurs in Massachusetts in Barnstable and Plymouth counties, its first occurrence in 1633 being the earliest recorded in this country. It appeared near Plymouth in 1633,

soon after the arrival of settlers, arousing considerable fear and apprehension.

The following account is given in Nathaniel Moreton's "New England's Memoriall," and the facts as given are corroborated by Governor Bradford, Rev. Wm. Hubbard and Mr. Prince, in Prince's "Annual." Speaking of a sickness which broke out in and near Plymouth in Massachusetts in 1633, he says: "It is to be observed that the Spring before this Sickness, there was a numerous company of Flies, which were like for bigness unto Wasps or Bumble-bees. They come out of little holes in the ground and did eat up all the green things, and made such a constant yelling noise as made all the woods ring of them, and ready to deaf the hearers; they were not any of them heard or seen by the English in the Country before this time. But the Indians told them that sickness would follow and so it did, very hot in the months of June, July and August of that Summer," viz., 1633. He says: "Toward Winter the sickness ceased," and that it was "a kind of a pestilent Fever."

How widely this brood was distributed at this time cannot be stated, but careful study of more recent appearances shows that this, like most other broods, is slowly but surely decreasing in size. At present it is the largest in Massachusetts, and seems to have held its ground most successfully; this may be due to the more favorable natural conditions of the country it occupies. The brood is, generally speaking, shut into the western part of Barnstable County, — on the west by the neck at Buzzards Bay and Sandwich, and on the east by the neck at Barnstable harbor and Yarmouth. Most of the brood is enclosed within these two bounds, but with a little overflow on each side. On the west this overflow extends as far as Manomet Point and Cook's Pond. In 1804 the brood appeared in great numbers 1½ miles west of Plymouth, but no further record of this part of the brood can be found, and it probably soon died out. On the eastern side the overflow extends at least into Dennis.

The brood made its last appearance in 1906. In order to ascertain the exact distribution and abundance of this brood, Dr. H. T. Fernald, through the co-operation of the State Board of Agriculture, sent circulars to each town where the cicada might be expected to appear, and from the information received

in this way, and from other sources, the following statement has been prepared: —

Places.	Remarks.	Observer.
Manomet,	Very numerous.	H. M. Russell. E. A. Back.
Cook's Pond,	A few.	T. R. Watson.
Wareham,	A few; heard not seen.	H. J. Franklin.
Onset,	A few.	J. C. Hammond.
Bourne,	Very numerous, flying even into one's face.	H. J. Franklin. D. D. Nye.
Wing's neck (Bourne),	Very numerous; flying even into one's face.	D. D. Nye.
Sandwich,	Very numerous.	J. C. Hammond. H. J. Franklin.
Mashpee,	Very numerous.	J. C. Hammond. H. J. Franklin.
West Falmouth,	Very numerous; woods ring with their voices.	D. R. Wicks.
Falmouth,	Very numerous.	H. J. Franklin.
East Falmouth,	Very numerous.	H. J. Franklin.
North Falmouth,	Very numerous; "Psyche," December, 1906.	C. W. Johnson.
Barnstable,	Very numerous.	H. J. Franklin.
West Barnstable,	Very numerous; no great damage.	J. C. Hammond. J. Bursley.
Osterville,	Very numerous; "Psyche," December, 1906.	C. W. Johnson. A. H. Armstrong.
Yarmouth,	Reported.	-
Dennis,	- - -	J. C. Hammond.

Letters were also sent to the following places, but no cicadas were reported: Truro, Eastham, Chatham, Harwich, West Brewster, Carver, Rochester, Acushnet, Plympton, Lakeville, Halifax, Dartmouth, Berkley, Hanson, Seekonk, West Duxbury, Attleborough, Campello, Franklin, Stoughton, Mansfield, Pembroke, Norwood, Westwood, Walpole, Bridgewater, West Bridgewater, Bellingham, Norwell, Millis, Canton.

From this it will be seen that the brood is generally distributed between Manomet, Wareham and Dennis, being strongest between Sandwich, Bourne, Falmouth and Osterville. In this central part the brood seems to be as strong as ever, but along the outside, in what I have called the overflow, it is gradually running out. It must be remembered, however, that these cicadas in Plymouth and Barnstable counties form only a part of this brood.

In 1889 Riley and Howard gave its extent as follows: —

The region commences in southeastern Massachusetts, extends south across Long Island and along the Atlantic coast of New Jersey, Delaware and Maryland, as far as Chesapeake Bay; then up the Susquehanna in Pennsylvania to a point a little below Harrisburg; thence

northwest in Ohio, embracing the southwestern corner of the State and the northwestern portion of Kentucky, and then upward through southwestern Indiana, ending in central Illinois.

1849. (Riley, XX.) Brood VIII.

Dukes. 1917.

Occurrence.

Martha's Vineyard: 15 square miles of Central Plains, 1833 to 1900.

This is one of the smallest broods and covers a quite compact territory, the greater part of which lies in central and western Pennsylvania and eastern Ohio, with a few localities in northern West Virginia and southwestern New York. Two widely separated swarms listed from Illinois and South Carolina are extremely doubtful, and both are probably based on confusion of some of the annual species with the periodical cicadas. The Massachusetts part of this brood, occurring in Dukes, is also widely separated, but is fully established and has been well recorded since the time of Harris. Dr. Harris records their first appearance in Martha's Vineyard in 1833, while Smith's "Register" gives the next in 1849, and Geo. H. Luce of West Tisbury, Mass., states that they were there in 1849–66–83 and 1900. In the "American Naturalist," October, 1883, G. E. Bessey writes: —

> While driving across "the plains" of the central part of Martha's Vineyard, in the last few days of June of this year, I observed large numbers of the periodical cicadas. The scrub-oaks, which here cover the whole ground, were literally alive with them. The insects were confined to a narrow belt, not exceeding half or three-quarters of a mile in width and of unknown length.

At its last appearance, in 1900, it seemed desirable to ascertain the accuracy of previous observations and learn whether this isolated colony was holding its own. Through the kindness of Mr. Luce it was learned that "the brood was a well-known one and as much in evidence as ever. They were quite numerous, but seemed to confine themselves to a district known as the plains district, — a tract of land covered with scrub-oak and very lightly wooded. They could be heard more than a mile, making

a peculiar sound. As near as I could ascertain they covered about 15 square miles of territory. . . . By good evidence they were here in 1849. One old man said within his lifetime he had seen them five times."

The first recorded occurrence of this brood in 1833, by Dr. Harris, was evidently a case of retardation in development, due probably to unfavorable weather, for they should have appeared one year earlier, in 1832. It seems strange that this swarm in Dukes should be part of a brood whose nearest occurrence is in central Pennsylvania, while brood XIV., in Barnstable and Plymouth counties, is only about 4½ miles away, across Vineyard Sound. At their (brood XIV.) last occurrence, in 1906, the cicadas were very numerous at Falmouth, which is just across from Martha's Vineyard, and with a favorable wind it would seem as though the passage might easily be made. On inquiry, however, it was found that no cicadas appeared on the island in 1906.

1852. (Riley, I.) Brood XI.

Bristol, Franklin, Hampshire. 1920.

Occurrence.

Massachusetts: Hadley, 1818; Westfield, 1835; Deerfield, Freetown (near Fall River), 1767, 1784, 1801, 1818, 1835, 1852, 1869.

Connecticut: Glastonbury, 1818, 1835, 1852; Suffield, 1818, 1869, 1886.

Rhode Island: Coventry, East Greenwich, Washington, 1869, 1886, 1903.

This is a small brood, formerly limited, for the most part, to the valley of the Connecticut River in Massachusetts and Connecticut, with one colony in the vicinity of Fall River and another near Coventry, R. I., separated from the main swarm. The "Boston Magazine" records the appearance of this brood in Bristol County in 1784, while Dr. Fitch reports it as having occurred in Hadley in 1818 and at Westfield in 1835. It was reported from Deerfield and Bristol County by Dr. Smith from 1767 to 1852, and the genuineness of the brood was fully established in 1867. It is evident that the brood had once a wide distribution, for in the "American Journal of Arts and Sciences" for 1862, Vol. 33, we read: "That part of our State

— Connecticut — which lies east of the Connecticut River has a different period from the western side. On the 22d of June, 1835, while traveling through Tolland County, Conn., in a stage coach, I passed through woods swarming with this *Cicada septendecim*." Also in Alonzo B. Chapin's "History of Glastonbury" we read of their occurrence in Glastonbury in 1818, 1835 and 1852. This is the most southern point in the Connecticut valley at which this brood has been reported. With the exception of the swarm at Suffield, Conn., no record can be found of the appearance of this brood in the Connecticut valley since 1852, and none in the Massachusetts part since 1835. Mr. Geo. Dimmock, who has made a special study of the swarm at Suffield, says that "These cicadas, of which there are records going back about a century, seem to be dying out. In 1869 they were so abundant that small bushes and underbrush of the rather sparse woods in which they occur were weighted down by them." In 1886 and 1903 he was unable to visit that region, but "was informed that very few of the insects appeared in 1886, and none in 1903."

The Bristol County swarm was observed at Freetown, near Fall River, in 1818, 1835, 1852 and 1869. "In 1818 they were very numerous, in 1852 still less, and in 1869 were quite scattering as compared with 1818." Since which time there is no record of their appearance.

In Rhode Island there seem to have been three visitations of this brood; in 1869, 1868 and certainly in 1903, when they were very abundant. It appeared near Coventry, East Greenwich and Washington, in isolated places, but not continuously over an extensive area. As far as we know this brood was most widely distributed in 1818, when it extended from Hadley, Mass., to Glastonbury, Conn., with a widely separated swarm at Fall River. Since then there has been a steady decrease of numbers, due probably to the cutting off of wooded lowlands and the extension of cultivated land. In 1869 they appeared only at Fall River, Mass., Suffield, Conn., and near Coventry, East Greenwich and Washington, R. I.

In 1903 the only occurrence of this brood was near Coventry, R. I., none being found in Massachusetts or Connecticut,

though close watch was kept. From this it would seem that the brood had died out in Massachusetts, but careful watch should be kept at the next occurrence, in 1920.

1851. (Riley, XXII.) Brood X.

Bristol. 1919.

Occurrence.

Rutland, Vt., 1851, 1868; Bristol County, Mass., 1834.

This is the largest brood of the seventeen-year broods, and equals, if not exceeds, in extent the largest thirteen-year brood, — brood IX. Its representation in Massachusetts, however, is, if authentic and still active, — which is very doubtful, — small and of no importance. The brood has been well recorded in the east from 1715 to 1902, the date of its last appearance. It occurs from Alabama and Wisconsin to Massachusetts, in greater or less numbers, and in 1851 and 1868 appeared at Rutland, Vt. According to Dr. Fitch, "What appears to be a detached branch of this brood occurs in the southeastern part of Massachusetts." It is probable, however, that there was some mistake about this occurrence.

1843. (Riley, XII.) Brood II.

New York and Connecticut near Massachusetts State Line. 1911.

Occurrence.

New York: Copake, 1877; Hillsdale (millions), 1894.

Connecticut: New Haven, 1724, 1894; Southington, 1894; New Britain, 1894; Farmington, 1894; Winsted, 1894.

This is one of the best-recorded broods, being distributed from New York and Connecticut to North Carolina, with isolated swarms in Indiana and Michigan. While no colony of this brood has been reported in Massachusetts, they come so close to the State line on the southwest that stragglers, at least, must have crossed into Massachusetts. At Copake, and especially at Hillsdale, N. Y., in 1894, there were vigorous colonies within 1½ miles of our State line, while in Connecticut, at Winsted, they came within 7 miles. Careful inquiry from the

Massachusetts towns along the southwestern boundary failed to bring out any appearance in this State. This was probably because only scattered members crossed into Massachusetts, and these, if recognized as cicadas, were probably confused with the annual species. That part of the State is also quite mountainous, and the cicadas would tend to go around rather than over the mountains, for as a rule they prefer the lowlands. In New York they are scattered down both banks of the Hudson below Troy, and in Connecticut, east as far as the Connecticut River. Professor Potter records their first occurrence in New Haven, Conn., in 1724, and since then they have occurred regularly every seventeen years. According to Lintner: —

> At its last appearance, in 1894, it was distributed throughout the Hudson valley below Troy, and especially at Hillsdale, near our State line, where millions were found. In Connecticut it was reported from the vicinity of New Haven, at Easthaven, near Lake Saltonstall, at Southington, New Britain, Farmington and Winsted, thus extending its range north nearly across the State of Massachusetts line. It doubtless occurred north of this locality, but no account of its appearance was received.

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